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BRUARY 1949

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

WELL POINTS DEWATER excavation for cutoff wall of Neversink Dam, Delaware Aqueduct, under construction by Board of Water Supply, City of New York. See article in this issue by Roger W. Armstrong.

Annual Meeting Technical Division Reports

Concrete Arch Provides 340-Ft Clear Span for Bomber Hangar—Prentiss

Construction Engineer Builds Organization for Awarding Agency—Page

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Delaware Aqueduct to Increase New York's Water Supply Fifty Percent

ROGER W. ARMSTRONG, M. ASCE
Chairman, Board of Engineering Consultants, New York
Board of Water Supply, New York, N.Y.

THE PROBLEM of keeping New York supplied with water is never ending. Before completion of the Catskill System it was necessary to start investigation of possible additional sources. The Delaware System now under construction was the result. This new aqueduct will deliver 540 mgd more to New York. The system includes three reservoirs and a pressure tunnel running 85 miles to the city. The three dams—Merriman, Neversink, and Downsville—are rolled earth structures, and are remarkably similar in site and design. The only difference is the construction of the cutoff wall at the Downsville Dam. In all cases the head of groundwater was so great as to require excessive air pressure in the caissons. This problem was overcome by the use of well points and drainage sumps. The tunnel to New York varies in depth from 300 to 2,500 ft below the original ground surface. The diameter increases as it approaches New York to a maximum of 19 ft 6 in. It is expected that the full system will be in operation by 1955. Until that time emergency demands will have to be met by nearby sources, which are now under consideration. Mr. Armstrong's original paper was presented before the Sanitary Engineering Division, at the ASCE Annual Meeting.

BARRING UNFORESEEN circumstances, the Delaware Water Supply System, which was proposed in 1927 for completion in 1939 at a cost of 273 million dollars, will be finished about 1954 at a present estimated cost of 440 million dollars. The construction has been delayed for several reasons—legal obstacles, financial stringency, and finally, inability to obtain construction equipment and materials during the period when the country was engaged in, and recovering from, the effects of the World War. The increase in estimated cost is chiefly the result of having to do a substantial part of the construction work during the postwar era of high costs, but an addition of 18 million dollars had previously been made to the original estimate because of a change in the location of the Neversink Dam which materially increased the size of the reservoir and the length of its effluent tunnel.

The general features of the Delaware System have been described in detail in articles in CIVIL ENGINEERING for September 1938 and August 1942. Briefly the system consists of impounding reservoirs on three Catskill Mountain streams (the East Branch of the Delaware River, the Neversink River, and Rondout Creek) and a pressure tunnel aqueduct from Rondout Reservoir to New York City. Water from the reservoirs on the East Branch of the Delaware and the Neversink River, both tributaries of the Delaware River, will be delivered to Rondout Reservoir through aqueduct tunnels 25 and 5 miles long respectively.

The new works will add 540 mgd of dependable yield to the city's water supply, increasing its present resources by about 50 percent. Of this quantity, 440 mgd will come from the East Branch and the Neversink Rivers, both tributaries of the Delaware River, and 100 mgd will come from Rondout Creek, a tributary of the Hudson River. The original plans included 160 mgd to be obtained by the development of three additional tributaries of the Delaware River (Beaver Kill, Willowemoc Creek, and the Little Delaware). This increment, however, can be obtained only by a favorable decision of the United States Supreme Court upon application by the city to divert

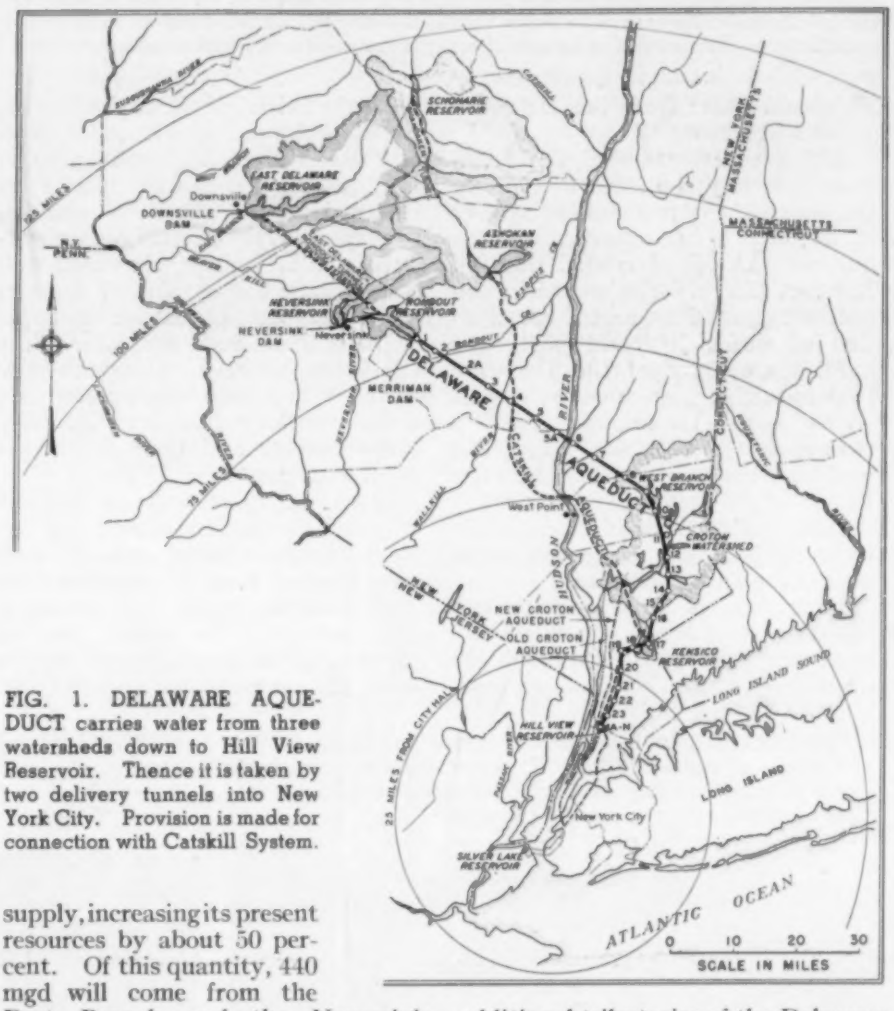


FIG. 1. DELAWARE AQUEDUCT carries water from three watersheds down to Hill View Reservoir. Thence it is taken by two delivery tunnels into New York City. Provision is made for connection with Catskill System.

PANORAMA OF NEVERSINK Dam site as it appeared upon completion of core wall. At extreme left is embankment which will become part of downstream slope. To left of trench are contractor's buildings, and behind them gantry crane is transferring concrete aggregate to hoppers of batching plant. Headers and discharge lines of Moretrench well point system are seen on either slope of trench. Wall in center of valley is irregular because of transition from 12-ft-wide caissons to 8-ft bottom width of wall. On extreme right is cofferdam and upstream embankment. Beyond that on far side of valley is gravel pit from which material was taken to fill shafts of caissons.

additional water from the Delaware River watershed.

Actual construction of the Delaware System was started in 1937 by the award of contracts for the sinking of 23 shafts of the aqueduct and the first contract for Merriman Dam on Rondout Creek. The award of ten contracts for the aqueduct construction followed in 1938 and 1939.

All three dams of the Delaware System are being constructed on sites which show a remarkable similarity with respect to their size, shape, and geological characteristics. The dams therefore are practically identical in design, and methods of construction differ in only one case—the cutoff wall at the Downsville site.

Each dam is a rolled-earth embankment with a concrete cutoff wall extending from bedrock through the overburden and up to about one-third the height of the embankment. At the Rondout Creek and Neversink River sites, the rock gorge is filled with water-bearing glacial till to a maximum depth of 180 and 125 ft respectively. In the deeper portions of these valleys, the cutoff wall was constructed by sinking a series of rectangular pneumatic concrete caissons to bedrock and later filling the joints between them with concrete. When caissons are seated and sealed, working chambers are filled with concrete and their shafts are filled with gravel.

Since the theoretical air pressure required to counterbalance the full head of groundwater was in each case greater than is permitted by New York State law, and because it was necessary to reduce the air pressure as much as possible for the sake of economy of construction, provisions were made for lowering the groundwater table by pumping.

The first contracts for the construction of both the Merriman and Neversink Dams provided for the sinking of two exploratory caissons in the deepest parts of the valleys. Each of these caissons was provided with pumps installed just above the working chamber for lowering the groundwater during the sinking of the exploratory and other caissons. At Rondout, deep wells were also driven at points adjacent to the cutoff and pumping from them was continued during the construction of the cutoff. These preliminary caissons served not only to demonstrate the feasibility of the method but also to furnish prospective bidders with information as to the materials that would be encountered in future work.

ROLLED EARTHFILL is being placed for Merriman Dam. Placing and rolling of upstream Class "B" embankment is in progress. Slopes of earthfill during construction are maintained at not less than 4 percent to provide surface drainage.

MATERIAL from upstream borrow pit at Merriman Dam is dumped through grizzly (foreground) where two circular screens reject stones over 5 in. for removal by truck and use in rock embankment. Conveyor carries screened fill to loading hopper.

At the Downsville site on the East Branch of the Delaware, the depth of the overburden is somewhat less than at the other two sites and it is expected that the cutoff wall may be constructed in an open trench without recourse to the caisson method. The contract for this work, however, is so written that caissons may be used if necessary.

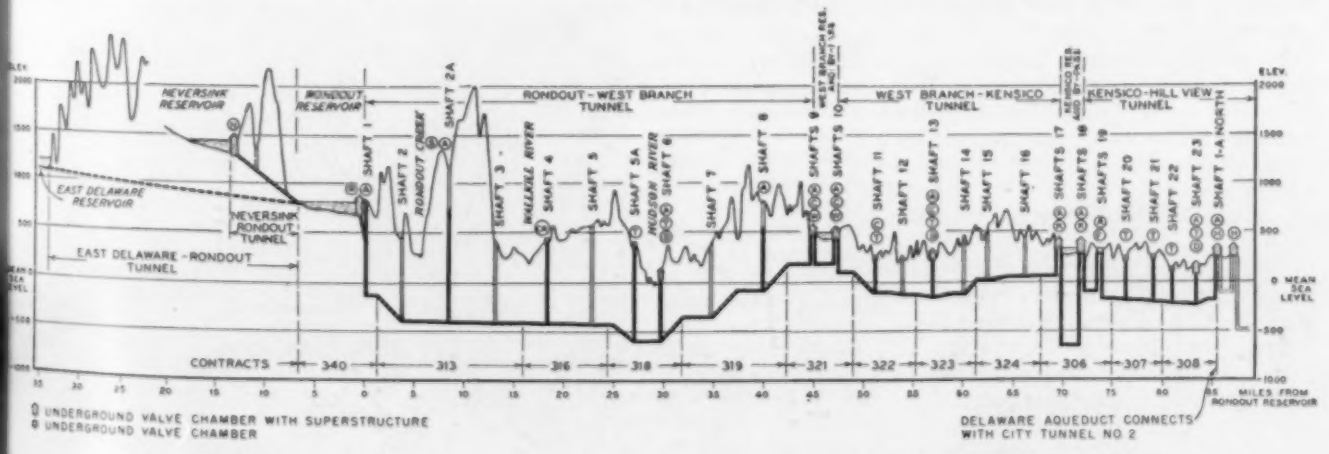
In each of the developments the stream is diverted during the construction period by a low dam upstream from the working area which directs the flow into a concrete-lined tunnel constructed through the rock abutment of the dam. At the Rondout and Neversink sites the diversion tunnel is 30 ft in finished diameter and at Downsville 40 ft. Both the diversion dam and the tunnel at each site are so designed that they will form a part of the permanent structure, the diversion dam eventually becoming the upstream toe of the main dam, and the downstream portion of the tunnel serving as the waste channel for overflow from the spillway. At all three sites an inclined tunnel forms the connecting link between the spillway and the waste channel.

The type of embankment for all three dams is the same, consisting of a central core of selected materials spread in 7-in. layers and rolled. Outside portions of the embankment are composed of materials not so critically selected, placed in 8-in. layers before compaction. Both upstream and downstream slopes will be covered with rockfill to a depth of about 12 ft. Compaction of the earth portions of the dams by sheepsfoot rollers is required and the specified degree of consolidation is determined from continuous inspection and tests by representatives of the Soil Mechanics Laboratories at the sites.

Pressure Tunnel Extends 85 Miles

The Delaware Aqueduct is a pressure tunnel located deep in bedrock and extending from Rondout Reservoir to Hill View Reservoir in Yonkers, N. Y., a total distance of 85 miles. The aqueduct is so located that it affords physical connection with the Croton System at the West

FIG. 2 **PROFILE OF DELAWARE AQUEDUCT gives location of 31 shafts, from 310 to 1,550 ft deep, in 85-mile length of tunnel. Functions of various shafts are explained in detail in legend below figure. Unmarked shafts are for construction only.**



NOTATION FOR SHAFTS

A = Affording access to tunnel.
C = Connection with reservoirs of Croton System.
CA = Connecting with Catskill Aqueduct.
D = Containing pumps for emptying tunnel when required.
S = Acting as surge shaft.
T = Having connections for supply of neighboring communities outside of New York City.

NOTATION FOR GATE HOUSES AND VALVE HOUSES

Will control flow as follows:
F = To and from Eastview filters when these are built on site already owned by city.
H = Into and out of Hill View Reservoir or through Hill View by-pass tunnel.
K = Into and out of Kensico Reservoir or through Kensico by-pass tunnel.
N = From Neversink Reservoir into Neversink-Rondout tunnel.
R = From Rondout Reservoir into Rondout-West Branch tunnel.
W = Into and out of West Branch Reservoir or through West Branch by-pass tunnel.

ARCH SECTIONS OF Neversink Diversion Tunnel are poured in 40-ft lengths. Concrete is transported from Rex Pumpcrete plant at portal through 8-in pipe running along left side of invert and extending upward through bulkhead and above arch form. Timber bulkhead at end of Blaw-Knox arch form is held by two sets of walers, one set bolted through steel rib of form, and another set, adjacent to rock, held by struts wedged against steel pins inserted in drill holes around bulkhead.

Branch Reservoir and with the Catskill System at Kensico and Hill View Reservoirs. A connection is also possible with the Catskill aqueduct where the lines of the two aqueducts cross near Gardner, N. Y., and with the Croton System at Shafts 11 and 13 adjacent to the Croton Falls and Cross River Reservoirs.

The tunnel varies in depth from 300 to 2,500 ft below the original ground surface. It is circular in section and lined with concrete to the following finished diameters: From Rondout Reservoir to the West Branch Reservoir of the Croton System, 13 ft 6 in.; from West Branch Reservoir to Kensico Reservoir, 15 ft 0 in.; and from Kensico to Hill View Reservoir, 19 ft 6 in. Bypass tunnels 15 ft 0 in. in diameter under both West Branch and Kensico Reservoirs, and a 21 ft 0 in. bypass under Hill View Reservoir, are provided.

The size of the aqueduct as it approaches the city was increased for the following reasons. Between West Branch and Kensico Reservoirs an increased capacity was provided to receive water from the Croton System which may be pumped into the aqueduct for delivery to the city at a higher level than is possible through the Croton aqueducts. A still greater capacity was provided below Kensico Reservoir not only to take care of hourly fluctuations in the draft if Hill View Reservoir should prove inadequate for this service, but also for the possible delivery of both Catskill and Delaware supplies and any future supply that may enter Kensico Reservoir.

The tunnel was constructed from 31 shafts at 26 locations, the majority of the shafts being retained as permanent adjuncts for the operation of the system. At West Branch, Kensico, and Hill View Reservoirs the Delaware water may be passed either through the reservoir or through the bypass tunnel. At these locations double shafts are provided for both influent and effluent with the controlling mechanism near the surface under low head. (The four shafts at Hill View Reservoir and the bypass tunnel connecting them were constructed in connection with City Tunnel No. 2.).

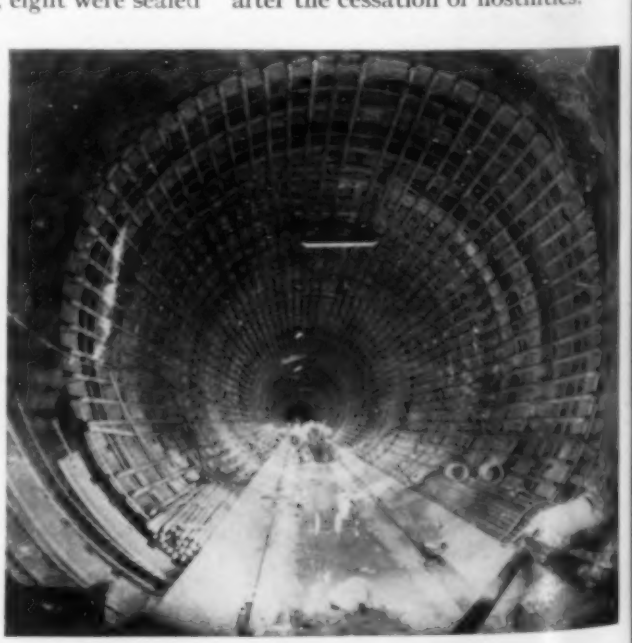
Three of the shafts located at the lowest point in each section of tunnel are designed and equipped for unwatering the tunnel. Such shafts are placed about 100 ft from the tunnel and are connected with the tunnel by an access drift which is closed off by a tight bronze door. At the foot of the shaft a chamber is provided with foundations for pumps and valved connections to a suction pipe from the tunnel. A discharge pipe and a dry well with elevators extend from the pump chamber to the surface.

Nine of the shafts, including the three drainage shafts, are equipped with risers and gate valves in surface chambers, thereby providing for future connections to supply nearby communities. Only ten of the shafts were sunk merely for construction purposes. Of these, eight were sealed permanently at the top and bottom with concrete plugs, while the remaining two, the tops of which are well above the hydraulic gradient, have been left open as breathers.

Gates for regulating the flow in the Delaware Aqueduct are installed in subsurface chambers at the inlet of Rondout Reservoir and at both inlet and outlet of West Branch, Kensico and Hill View Reservoirs. These subsurface chambers are surmounted by superstructures of substantial and pleasing design which contain the gate operating mechanisms. At the effluent chambers chlorinating equipment and chlorine storage rooms are provided. At the Kensico inlet an additional building is equipped with storage bins and apparatus for applying chemicals other than chlorine to the water whenever it becomes necessary or desirable. No filtration of the Delaware supply is contemplated at the present time but a chamber equipped with gates but without superstructure has been constructed at Eastview about 2 miles below Kensico Reservoir for future connection with a filter plant when such treatment becomes desirable.

War Shortages Delay Construction

Driving and lining of the Delaware Aqueduct tunnel very fortunately were completed before the requirements of the armed forces in the prosecution of the war made construction materials and equipment for other than war work impossible to obtain. The large sluice gates in some of the control chambers had been installed but their operating mechanisms and all other operating equipment could not be secured until after the cessation of hostilities.



SPECIAL REINFORCING was required for 600 ft through this section of faulted and disintegrating limestone in Rondout-West Branch Tunnel. Reinforcing consists of 1-in. square, twisted bars, supported in notches in $6\frac{1}{2} \times 6\frac{1}{2}$ ties 6 ft 0 in. on center. Steel interlining of 1-in. plate will be erected inside reinforcement, with inner lining of concrete. In this view concrete subinvert has been placed to support rails on which 5-ft $3\frac{1}{2}$-in.-long rings of steel plate interlining will be moved forward.

Contracts for construction of Merriman Dam, for diversion of the Neversink River, and for the sinking of exploratory caissons for the Neversink Dam cutoff were awarded before the scarcity of materials and equipment became critical. The latter contract was completed but work on the Merriman Dam became more and more difficult until in 1944 it became evident that completion, or even further progress, was impossible, and an agreement with the contractor to cancel the contract was executed. Several contracts for operating equipment which were awarded before the war and which could not be completed because of demands on the contractors for war materials, were continued in force, and work was resumed after the cessation of hostilities.

When it again became possible to obtain construction materials and equipment, contracts were awarded for completion of the Merriman Dam, for construction of the Neversink Dam, for diversion of the East Branch of the Delaware River, for the cutoff wall of the Downsville Dam, and for the furnishing and installation of operating equipment for the Delaware Aqueduct. Work is now progressing on all three dams, and operating equipment is being installed in the gate chambers of the aqueduct as fast as deliveries are made.

Emergency Sources Developed

In the period 1930 to 1942, during the depression and the period when workers were moving to war industries elsewhere, the rate of consumption of water in New York City remained stationary or fell off slightly. In 1943, however, industrial activity in the New York area began a sharp recovery and, with the return of men from military service, the consumption began to increase at a phenomenal rate, continuing without much abatement to the present time. It became evident that this condition might result in a deficiency in the supply if a series of years of low rainfall occurred. Even with an abundant supply of water in storage, the capacity of the existing aqueducts has been taxed to the utmost.

As a partial relief for this condition a small tunnel was driven between Shaft 1 of the Delaware Aqueduct and Rondout Creek. Control gates were installed at the inlet end and the unregulated flow of Rondout Creek up to a maximum of about 250 mgd was allowed to enter the aqueduct. This diversion in the $4^1/_2$ years that it has been in operation has added an average of about 100 mgd to the supply available to the city.

The Catskill and Croton Aqueducts are carrying water to their full capacity, and the Delaware Aqueduct alone is not being fully used. Because of the rising demand for water in the city, the increased use of the Delaware Aqueduct is not only desirable but also imperative if a serious shortage is to be averted. The completion of the Merriman Dam this year and the probable accumulation of some storage in the Rondout Reservoir from the spring rains of 1950 will add only a small amount to the yield now obtained from Rondout Creek. The Neversink River will furnish an estimated 105 mgd, but not until about 1952; and the 335 mgd from the East Branch of the Delaware will not be available until about 1955.

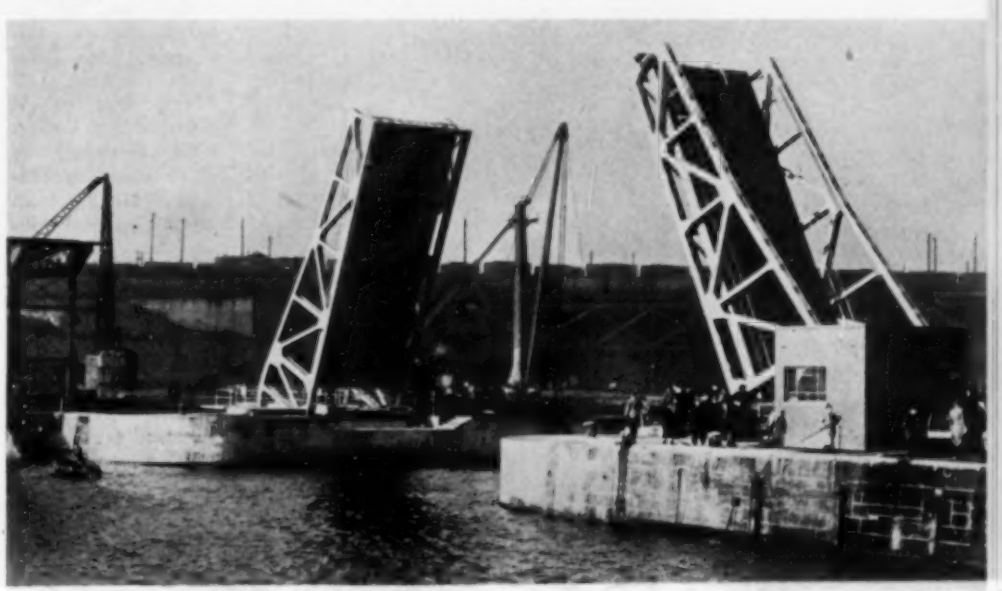
Meanwhile, studies now in progress have as their object the introduction into the Delaware Aqueduct of a temporary supply from some adjacent source to take care of an emergency. Except for two or three small streams which may be diverted directly into the Rondout Reservoir, such additional water will necessarily be a pumped supply introduced into the aqueduct through one of the shafts. The difficulties encountered in this procedure arise from the fact that the shafts nearest the streams which are available for such emergency supplies are generally shafts that were used for construction purposes only and were sealed at the bottom by concrete plugs 30 to 50 ft in depth. To remove these plugs and install the necessary controlling mechanisms would not only be extremely costly but would also involve shutting down the aqueduct for a considerable period during which the partial relief resulting from the delivery of the natural flow of Rondout Creek would be lost.

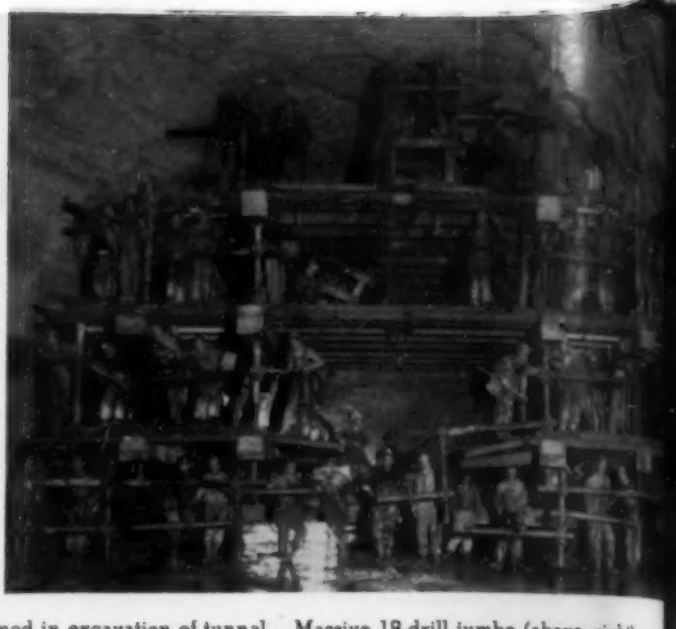
A limited supply from the Hudson River could be delivered to the tunnel through a riser which is included in the drainage shaft located on the east side of the river. Such a supply would not require the expense attendant on the use of one of the plugged shafts for entrance into the tunnel nor would it necessitate the shutting off of the flow from Rondout Creek for any great length of time. It would, however, be limited by the size of the existing riser to about 100 mgd and the water would require extensive purification to bring it up to the U.S. Public Health standard for a potable water supply.

The furnishing of an adequate water supply for New York City is a never ending problem. Before the completion of the Catskill System it was found necessary to start investigations for new and additional sources and the same is now true with respect to the Delaware System. Studies are now in progress to this end for, unless the rate of increase in consumption drops off materially, additional water will be required shortly after the full yield of the Delaware sources becomes available.

First Aluminum Bascule Bridge in Great Britain Connects Docks at Sunderland

SPANNING A 90-FT-WIDE WATERWAY between two docks, an aluminum bascule bridge was recently put in service in Sunderland, England, the first of its kind in Great Britain. The bridge weighs 54 tons and can be raised in about a minute. Head Wrightson & Co. of Thornaby, Yorkshire, built the structure at a cost of about $340,000.





DOWNSVILLE DIVERSION TUNNEL (left) extends 2,100 ft through north abutment of dam. Tunnel is excavated to 45-ft dia for finished diameter of 40 ft. Structural steel roof support is used in structurally poor sandstone formation for 50 percent of tunnel length. Invert concrete is placed before arch section. Presswell pressure blowers, working from each portal, place lining concrete. Six months were consumed in excavation of tunnel. Massive 18-drill jumbo (above, right) contributed to rapid progress which averaged about 15 ft per day. Jumbo was moved back during blasting, and muck was removed by trucks which were loaded by No. 6 Northwest electric shovel. Center section of jumbo was folded out of way to permit passage of trucks and shovel. Jumbo was pushed into place by bulldozer. Maximum anticipated diversion flow of 31,400 cfs was used as design basis. Eventually tunnel will carry overflow from reservoir and compensating waters for lower users on Delaware River, as decreed by U.S. Supreme Court.

Diversion Tunnel and Core Wall at Downsville Near Completion

JOHN S. MACDONALD, M. ASCE

Vice-President, Walsh Construction Co., New York, N.Y.

DOWNSVILLE DAM, last of the three earthfill dam contracts of the Delaware System to be awarded, will form the largest reservoir of the system. As reported in the December issue of CIVIL ENGINEERING, (page 68) the diversion tunnel has been holed through. The lining will be completed about June 1 of this year and the river will be diverted about a month later. Included under the present contract are construction of the core wall, diversion tunnel, outlet channel, inclined shaft for reservoir overflow, and the cofferdam which diverts the river into the tunnel and will become part of the dam fill. Construction of a channel to carry overflow beyond the capacity of the shaft and tunnel; completion of the earthfill dam; and construction of the connection from the Pepacton Reservoir to the East Delaware Connecting Tunnel, described by Mr. Armstrong in the preceding article, are to be awarded under other contracts.

CORE-WALL EXCAVATION for Downsville Dam (below, left) extends across valley to river bank. Core wall is erected in sheeted trench using DP2 steel sheeting. (Caissons are used instead at Rondout and Neversink Dam sites.) For single-stage sheeting, trench is 8 ft wide. Where double-stage sheeting is necessary, upper sheeting lines are 14 ft apart and lower sheeting lines, 10 ft. Except for 14-ft width, where trench is backfilled 3 ft on each side of core wall, sheeting is used as forms for concreting, concrete being grouted to bedrock. Drainage installations include caisson in center of excavation, used as pump sump, and Moretrench well points capable of pumping about 5,000 gpd. All drainage is settled and chlorinated before discharge into Delaware. Inclined shaft (right) will permit overflow from Downsville Reservoir to enter diversion tunnel. Muck from excavation of inclined shaft is dropped down pilot shaft, previously driven, and removed through diversion tunnel portal. Equipment shown in excavation will also be removed through diversion tunnel.

Sanitary Engineers Study
Variety of Problems at Three Technical Sessions

COMMITTEE REPORTS and papers on a variety of subjects ranging from cold weather problems to status and opportunities for sanitary engineers in the Armed Services

H. M. Freeburn, Chairman, Sanitary Eng. Div.; Chief Engineer, Philadelphia Suburban Water Co., Bryn Mawr

highlighted three sessions of the Sanitary Engineering Division, over which H. M. Freeburn, Philadelphia, chairman of the Division's Executive Committee, presided.

Following introductory remarks by Mr. Freeburn, Col. W. A. Hardenbergh, Editor, *Public Works Magazine*, New York, presented a paper on "Cold Weather Sanitary Engineering Problems." Other papers presented at the first session were: "Status and Opportunities for Sanitary Engineers in the Armed Services," by Clarence W. Klassen, Chief Sanitary Engineer, Illinois Department of Public Health, Springfield, Ill.; "Control of Water Resources by Zoning," by Howard T. Critchlow, Chief Engineer, Division of Water Policy and Supply, New Jersey Department of Conservation, Trenton, N.J.; and "Report of the Committee on Refuse Collection and Disposal," by Prof. Rolf Eliassen of New York University's Sanitary Engineering Department.

At the second session, the following committee reports were presented: "Rates and Rate Structures for Water and Sewage Works," by S. A. Greeley, Chicago; "Advancement of Sanitary Engineering," by Prof. Herman G. Baity, University of North Carolina; "Water Supply Engineering," by Thomas H. Wiggin, New York. In addition, Arthur S. Gorman, U.S. Atomic Energy Commission, Washington, D.C., presented a paper, "Problems of Nuclear Fission Operations and the Sanitary Engineer."

The following papers were presented at the third session: "The Delaware Water Supply System of the City of New York," by Roger W. Armstrong, chairman, Board of Engineering Consultants, Board of Water Supply, City of New York, which is printed elsewhere in this issue; "Industry and Its Waste Treatment," by L. L. Hedgepeth, Staff Technical Consultant, Calco Chemical Division, American Cyanamid Co., and former Executive Secretary, Virginia State Water Control Board, Richmond, Va.; "Federal Water Pollution Control Act, U.S. P.H.S. Program," by Mark D. Hollis, Assistant Surgeon General, Chief Sanitary Engineer, U.S. Public Health Service, Washington, D.C.; and "Federal Works Agency Program," by J. W. Follin, Assistant Administrator, Federal Works Agency, Washington, D.C.

W. A. Hardenbergh

Present sanitary engineering knowledge is far from complete so far as the arctic is concerned, but aside from such problems as those dealing with permafrost, it appears that arctic sanitary engineering problems can be solved, Col. Hardenbergh declared in his paper, which concluded:

"This can be done with relatively small additions to our present knowledge. We need to know more about the treatability and the qualities of the surface waters of the arctic; we need to know more about such factors as chlorine demand and chlorination reactions at very low temperatures. We will probably have to brush up our knowledge of insulation properties and heat conservation.

Field equipment suitable for water supply and waste disposal under very-low-temperature conditions must be developed and standardized. Possibly this cannot be done satisfactorily until the service for which they will be required is more clearly defined. We must have a sounder and broader basis of knowledge of arctic conditions and a better idea of what our arctic requirements are going to be. When we have that, I believe we can solve the sanitary engineering problems of the cold-weather country; and we will also be better able to solve the problems of shelter, ventilation, heating and clothing, which are highly important for those who have to live or work or serve in the arctic."

Howard T. Critchlow

"The importance and necessity of maintaining a groundwater supply to assure a safe sustaining yield cannot be overemphasized," Mr. Critchlow asserted in his paper in reviewing statutes to regulate diversion of water and to protect the public against wasteful use.

"Such statutes fall within the exercise of the police power," Mr. Critchlow said, "and where they have been reasonably adopted for the sake of fairness and equity and to prevent the waste of natural resources, the statutes have been upheld."

Mr. Critchlow discussed particularly New Jersey laws and told of the enactment as far back as 1907 of a law establishing a state water supply commission to regulate the diversion of surface water for public and potable use.

"For 40 years of operation of the statutes on the control of water for public and potable use in New Jersey," he said, "there was no state control over private wells for industrial, commercial or other private use. The public supplies were thus subject to unrestricted interference by private wells that might be constructed and operated within their sphere of influence. For ten or more years, relief was sought through legislation. Objections were raised by the owners of large wells using water in industries, railroads, hotels and other businesses.

"Finally, in 1947, a law was enacted giving authority to the State Department of Conservation to regulate the diversion of subsurface and percolating water of the state for domestic, industrial and other uses. Under this legislation two so-called 'protected areas' have been established and a third is being proposed."

L. L. Hedgepeth

Increasing technical knowledge of process control should be utilized with a knowledge of human relations to lessen the pollution load on streams, Mr. Hedgepeth asserted in his paper.

"Tasks of considerable size lie ahead of stream sanitarians in their work for the protection of presently clean streams and the restoration of those now polluted," he said. "Some

of those awaiting performance are of sobering magnitude. Many, and I believe the great majority, will respond to a sound technical approach. On others we have much to learn before success may be expected.

"I have found that the employment of utter practicability in the interpretation of law, of data and in the determination of practicable goals of attainment, is a profitable method of attack.

"A program based on forthrightness, tact, good will, and good faith is infinite in its possibilities. Successfully prosecuted, it discourages the development of widely divergent and incompatible views. By keeping discussions on a practical level, it also discourages wishful thinking by government and industry and thus avoids much misunderstanding."

Mr. Hedgepeth cited examples of cooperation effectuated with Virginia industries and stressed the economic importance of industries to the various states as well as the need for careful weighing of the esthetic and recreational values on the one hand against the economic values on the other.

Herman G. Baity

The ASCE was called upon to act as "the stimulating and motivating agency" in effecting joint action of representatives of various organized groups in the sanitary engineering field, in the report presented by Professor Baity in behalf of the Committee on Advancement of Sanitary Engineering.

"Perhaps the greatest possible service that can be rendered to sanitary engineers and to sanitary engineering would be to bring the diverse professional groups into some kind of mutual acquaintanceship and understanding," the report asserted.

"It is recommended that the present divisional Committee on the Advancement of Sanitary Engineering be discharged, and that a new joint committee of the same name and purpose be authorized, but with representation to be invited from the following organizations in addition to the Sanitary Engineering Division, ASCE: Engineering Section of the American Public Health Association, American Water Works Association, Federation of Sewage Works Associations, American Chemical Society, National Society of Professional Engineers and American Society for Engineering Education. It is suggested that the representation from each of these associations be determined by the Executive Committee of the Sanitary Engineering Division, ASCE, and that the joint committee be authorized to organize and conduct its business in the same manner as other similar inter-society committees.

"It is believed that over the years the contributions of such a joint committee can be immeasurably greater and more effective in advancing sanitary engineering practice than the best efforts of any committee representing only a part of this professional group."

Defense against atomic and bacterial warfare makes the need for training sanitary engineers especially acute, yet none of America's Armed Services "offer any incentive to draw qualified personnel into the services or to build a competent sanitary organization in any of them," Professor Baity pointed out in another portion of the report.

"Substantial progress has been made in recent months toward a clearer definition and response in regard to the role of the sanitary engineer in problems associated with nuclear fission operations," he said. "The Atomic Energy Commission, under whose purview fall all matters relating to such operations, has now found it desirable to acquaint the profession with several aspects of these problems as related to environmental sanitation, reversing a policy wherein it first appeared that only the most limited participation of the profession in the development of safeguards would be permitted. It was argued aggressively and persuasively by leaders in the profession that protection of man and his environment against the hazards of radioactivity fell into areas of responsibility that could be serviced by the sanitary engineer. Therefore it followed that the sanitary engineer should be made acquainted with the problems of nuclear fission operations, especialy in the disposal of wastes to the atmosphere, to the soil and to surface waterways.

"As to bacterial warfare, there has been no intimation yet—at least publicly—of the kind or scope of probable protective measures. It is not unlikely, however, that conventional tests for the detection of contaminants would have to be reexamined in order to provide more positive means for detection of pathogenic organisms during periods of possible attack. And since the means adopted for transmission of some diseases could be far different from those that operate under natural conditions, entirely new techniques for sanitary control might be called into application."

Asserting that the expansion authorized in the Army, Navy and Air Forces "will certainly result in an increased need for sanitary engineering services," Professor Baity declared that "conditions of employment and service will be such that they will appeal only to the lower-grade men."

James W. Follin

Control and abatement of water pollution was called "a number-one national problem" by Mr. Follin in detailing plans for construction of sewage installation works estimated to cost between three and five billion dollars.

Emphasizing that enactment by the 80th Congress of Public Law Number 845 "doesn't mean that the Federal Government has decided to shoulder the basic responsibility," Mr. Follin said:

"The law clearly declares it to be the policy of Congress to recognize, preserve and protect the primary responsibilities and rights of the states in controlling water pollution. However, the act proposes to support and aid technical research, and to provide federal technical services to state and interstate agencies and to industries, and also financial aid to state and interstate agencies and to municipalities in shaping and executing their stream pollution abatement programs."

Detailing the procedures for obtaining loans and grants, Mr. Follin called the legislation which, he said, makes partners of the Surgeon General of the Public Health Service and the Federal Works Administration "unique," and expressed the hope that it would set a pattern for other federal programs.

"We feel sure," Mr. Follin said, "that this type of cooperative program will succeed, as has been true of our program which provided temporary educational facilities for veterans, where the Office of Education determined the need and the Federal Works Administration saw to the construction.

"The task ahead of us is both imposing and inspiring. The U.S. Public Health Service has estimated the possible cost of initial installations at $3 to $5 billions, with about a third to go to sewage treatment plants, and the balance to collecting and intercepting sewers. Even in these days of astronomical figures, this is a substantial sum. For many years to come, there will be a heavy call for sanitary engineers and other technical people, and heavy demands upon skilled workers, upon contracting organizations, upon materials and equipment manufacturers. This legislation will gradually set in motion forces of considerable magnitude.

"The objective, to clean up the nation's waters, is one on which we all agree. I think we can also agree

that correction of the pollution of interstate waters in populous and highly industrialized areas is almost impossible without close cooperation at all levels of government. And this in turn will demand full understanding and good will on the part of public officials, private industry and professional people like yourselves."

Federal Aid Is Called

Insurance Against Ill-Advised Planning in Fight on Pollution

FEDERAL AID for the more than three billion dollars worth of war-postponed sewage treatment works and other installations which states and communities need in order to clean up the nation's waters was called "insurance against hasty, ill-advised construction" by Gen. Philip B. Fleming, Washington, D.C., Administrator, Federal Works Agency, in an address delivered before a joint session of the ASCE Sanitary Engineering Division, the New York State Sewage Works Association and the American Water Works Association in the Hotel Statler on the final day of the 96th Annual Meeting of ASCE.

Other papers presented at the joint session include: "The Effect of Sea Water on the Biochemical Oxidation of Sewage," Prof. Harold B. Gotaas, University of California; "A Novel High-Rate Anaerobic Waste Treatment System," co-authors Harry W. Gehm, Technical Adviser, National Council for Stream Improvement, New York, and Prof. Philip F. Morgan, University of Iowa; "Plans and Progress for the Tenth Addition of Standard Methods," Harry A. Faber, chairman, Joint Editorial Board; "Pollution Control Legislation in New York State," Harold C. Ostertag, Assemblyman, and chairman, Joint Legislative Committee on International Cooperation; and "The Twenty-Sixth Ward Sewage Treatment Works, Brooklyn, N.Y.," S. W. Steffensen, Project Manager, Department of Public Works, New York, N.Y.

According to Professor Gotaas, results of tests and investigations by numerous researchers indicate that in low concentrations of sea water (up to about 2½ percent) the rate of biological oxidation is larger than in fresh water. As concentration further increases, the rate of oxidation decreases until in straight sea water it is less than in fresh water.

"When the eight-million-dollar 26th Ward Sewage Treatment Works, now nearing completion, is placed in operation," Mr. Steffensen related, "no city sewage will be discharged into Jamaica Bay, Long Island, without receiving a fairly high degree of treatment." The plant will be capable of treating 60 mgd of sewage by the high-rate activated sludge process. The plant, which will serve 480,000 Brooklyn people, will utilize gas generated during digestion of sludge in engines to produce electric power.

Philip B. Fleming

"Today more than 9,100 towns with over six million people living in them need complete sewerage systems," General Fleming said. "In nearly 10,000 additional communities, where almost 80 million people live, the sewerage systems need improvement. I think all of us would agree that towns of more than 5,000 population need sewers—yet we actually have 81 which now lack sewers. Eight states—California, Illinois, Michigan, Missouri, New Jersey, New York, Ohio and Pennsylvania—each needs more than 100 million dollars worth of sewerage works. New York State, which requires something over a billion dollars, heads the list and accounts for almost 30 percent of the national total.

"These and other estimates furnished by the Public Health Service show why this country needs more than 80,000 miles of sewers, at least 12,000 new treatment plants, and additions to some 1,000 existing treatment plants."

Hailing Public Law 845, enacted by the 80th Congress, as "a new appr ach to an old and very troublesome problem," General Fleming said that this bill sets up a program of federal aid to local and state governments and to interstate authorities as a broad attack on water pollution.

"A large part of the responsibility for the successful administration of the program is vested in the Surgeon General," General Fleming said. "His duties include promotion of research in all phases of the problem. In cooperation with the several state governments and interstate authorities, the Surgeon General will draw up comprehensive programs for eliminating and reducing the pollution of interstate waters. These duties include the determination of the extent and character of stream pollution, the effect of such pollution upon the health of the people, the need for pollution abatement and other health matters.

"The Federal Works Agency Administrator is authorized to make loans to state and local governments for the construction of necessary treatment works, and for the preparation of reports, plans and specifications in connection therewith; and to make grants to aid in financing the cost of various studies, engineering designs, working drawings and other action preliminary to the construction of projects. No loan or grant can be made unless it is approved by the appropriate state or interstate water pollution agency and the Surgeon General and is a part of the comprehensive program developed pursuant to the act."

Pointing out that under the War Mobilization and Reconversion Act, federal aid in the amount of 59 million dollars was advanced to states and municipalities to plan needed public works, General Fleming said the new anti-pollution legislation offers similar opportunity for encouraging community foresight.

"As a result of this nation-wide stimulus," General Fleming stated, "plans for some 7,100 useful projects are under way. When completed they will represent a building program estimated to cost nearly 2.5 billion dollars of non-federal funds. This total includes 1,383 sewage disposal projects with an estimated total cost of about $400,000,000. The FWA advanced nearly $10,687,000 for engineering studies and planning to bring these projects to the contract bidding point."

"Such a program," he declared, "not only makes possible a more orderly flow of public construction in busy times like the present, but can help to maintain a shelf of live projects—against the day when private construction falters."

Harold C. Ostertag

Every watershed in New York State is suffering from pollution, according to Assemblyman Harold C.

(*Continued on page 91*)

Higher Fares Suggested for On-Time Landings to Increase Reliability of Aviation

A PROPOSAL for classification of air travel along lines similar to those used by railroads and steamship companies, obsolescence of airport terminal buildings, and other aviation problems were highlights of papers presented before the Air Transport

Alfred J. Ryan, Chairman, Air Transport Div.; Crocker & Ryan, Denver, Colo.

Division. Alfred J. Ryan, Denver, chairman of the Division's Executive Committee, presided.

Papers presented were: "Air Traffic Problems of the New York Region," by C. Earl Morrow, Chief Planning Engineer and Field Director, Regional Plan Association, Inc., N.Y.; "Airport Program of the Port of New York Authority," by J. C. Evans, chairman, Engineering Board, Port of New York Authority; "Maintenance of LaGuardia Airport as a Continuing Operating Terminal," by J. M. Kyle, Chief Engineer, Port of New York Authority; and "Terminal Design—International and Domestic Airway Transportation," by Thomas M. Sullivan, Engineer of Airports, Port of New York Authority.

C. Earl Morrow

Two or more classes of air travel, with rates "scaled to the chances of arriving on time at the desired port of destination," were suggested in his paper by Mr. Morrow as a "partial answer" to the problem of providing "reliability of service fundamental in the advance of aviation."

Class A schedules would be based on instrument landing and comparable with the extra-fare trains "which have the right-of-way on the tracks and which guarantee, more or less, an arrival on time at the desired port," he said. Citing an estimate that air lines lost $22,000,000 in canceled flights in 1947 and asserting that "the harm does not stop there, as people will get out of the habit of flying or never acquire it if air schedules don't become more reliable," Mr. Morrow estimated that instrument weather prevails in the New York district "about 20 percent of the time." He added:

"Class B schedules would put the passenger down at the desired port if the weather permits. Otherwise, he might find himself landing at Westchester Airport instead of LaGuardia; at Morristown instead of Teterboro; Hadley instead of Newark, or McArthur instead of New York International. At least he will know what to count on and may be willing to take a sporting chance to save a few dollars. It is possible that general weather conditions might have to be taken into account or else in a long stretch of fair weather, Class B travel might be too popular."

Mr. Morrow traced aviation's growth in the New York area over the last 16 years through charts.

"From the simple map of 1932, the charts have become progressively complicated as airline traffic has increased," he said, "until now it begins to look like a crazy quilt of airways, beams and fan markers. As a sample of recent increase of passengers in and out of the region, LaGuardia handled 760,000 in 1940, compared with 2,691,000 in 1947. In 25 years it is estimated that about 32,000,000 passengers will be serviced by scheduled aircraft in the region, which is about half the total number of passengers in and out of Grand Central Terminal in 1947. The question is what will air charts eventually look like? What about the efficiency of movement? Will a progressive piecemeal addition to the present system of controls be able to handle the situation?"

He advocated a long-range study of the traffic pattern in the New York district, stating: "Control facilities are costly and their establishment on a day-to-day basis may preclude a final arrangement that would be efficient and thus create an unnecessary bottleneck in the New York area that would materially affect air traffic throughout the country."

In support of his proposal for classification of passenger service, which he said has parallels in steamship as well as railroad travel, Mr. Morrow pointed out that "the capacity of an airport in contact weather will be several times what it is in instrument weather. If ultimately it takes only twice as long to land in instrument weather as it will in contact weather, there will still be a serious discrepancy."

Thomas M. Sullivan

Most terminal buildings "at practically every airport in the world" were too small one year after they were put into operation, Mr. Sullivan stated, calling on engineers to concentrate on "what to build rather than how to build it" in their work on airport terminal buildings.

"It behooves us to learn a lesson and plan the buildings for the maximum aircraft capacity that the runway configuration will permit," Mr. Sullivan said. He centered his paper around a hypothetical illustration of the interrelation between rules of design aimed at meeting needs of the growing number of airline passengers and the "number of aircraft that electronic engineers feel may be possible to land and take off on a dual runway in any one peak hour—namely, 120 movements per peak hour."

He advocated stage development in which only those portions of terminals are built which are required for airport traffic demand, through "integrating economic facts and technological assumptions with recognized terminal design data."

Pointing out that growth of commercial transportation, increased use of faster and larger aircraft, and the need to satisfy larger passenger demands have overcrowded present terminals, Mr. Sullivan said:

"Our thinking in connection with terminal construction has changed radically. Whereas, in our development of airports in the past the terminal buildings were hastily planned, we now comprehend the true value of this facility in relation to the development of the entire airport. If properly designed, the terminal will provide not only maximum service to passengers and airlines, but will also provide a large part of the airport's income through the medium of concessions located in the terminal building. It is easy to see that insufficient or careless planning of the terminal building can be and has been costly in the past. Every effort should be made to balance the expenditure for the building with the revenue from its operation."

(Continued on page 91)

Construction Engineer Builds Organization for Awarding Agency

JOHN C. PAGE, M. ASCE
Former Commissioner, U.S. Bureau of Reclamation, Denver, Colo.

WHAT ARE THE DUTIES and responsibilities of the owner's construction engineer and how do these duties differ from those of the contractor's engineer? In answering these questions, former Commissioner Page of the U.S. Bureau of Reclamation draws on his rich background of experience on large government contracts such as those for Hoover, Grand Coulee and Shasta Dams. His article deals specifically with the work of the Construction Engineer on large contracts in which the federal government is the contracting agency, but many of the principles discussed apply with equal force to other types of contracts. Mr. Page's original paper was presented before the Construction Division at the Society's Annual Meeting in New York.

THE POLICY of the Bureau of Reclamation on construction projects has gone through a complete cycle. Originally the Bureau's work was done by contract methods, then by force account, and finally by contractors under contracts awarded to the low bidder on the basis of unit prices bid and computed on estimated quantities. These quantities are carefully determined by geologists for the foundations, and by designing engineers for all other items of the completed structure.

On the basis of the writer's experience with the Bureau for many years, the following discussion deals with the procedure on construction work from the standpoint of the owner or awarding authority. Of course the writer's knowledge is primarily in the field of federal contracts but the procedure is typical of all contracts. In federal contracts the limitations are matters of law and such contracts therefore permit less latitude than do private contracts, emphasizing the need for good, fair administration of the contract. For example, all federal contracts must be on the standard form applying to all government construction. To a large extent the principles are the same for all contracts but certain special features of federal contracts should be recognized. Engineers engaged in this type of enterprise should learn these principles and requirements.

The engineer for the owner usually carries the title of Construction Engineer and that term will be so used here. Similarly the contractor's engineer is normally called Superintendent, which term is also so used here.

Functions of Construction Engineer

The Construction Engineer is boss, assuming that the man selected for the job is qualified and is so recognized by the owner in that sufficient authority is delegated to him to permit prompt decisions and planning to secure good progress and an orderly and efficient program of construction. The Construction Engineer has a variety of important jobs, the major ones being as follows:

1. To outline on paper the organization necessary to supervise and inspect the work in the period allowed in the contract, and from experience to select the key men in this organization. (See Figs. 1 and 2.)
2. To select and prepare the headquarters, including offices, warehouses, and in many cases the living facilities for his own organization.
3. To prepare or have prepared accurate and careful drawings to show the finished structure and its major parts. Many details must be added later to show just what the complete structure is and how it is to be built.
4. To prepare or supervise the preparation of specifications to cover

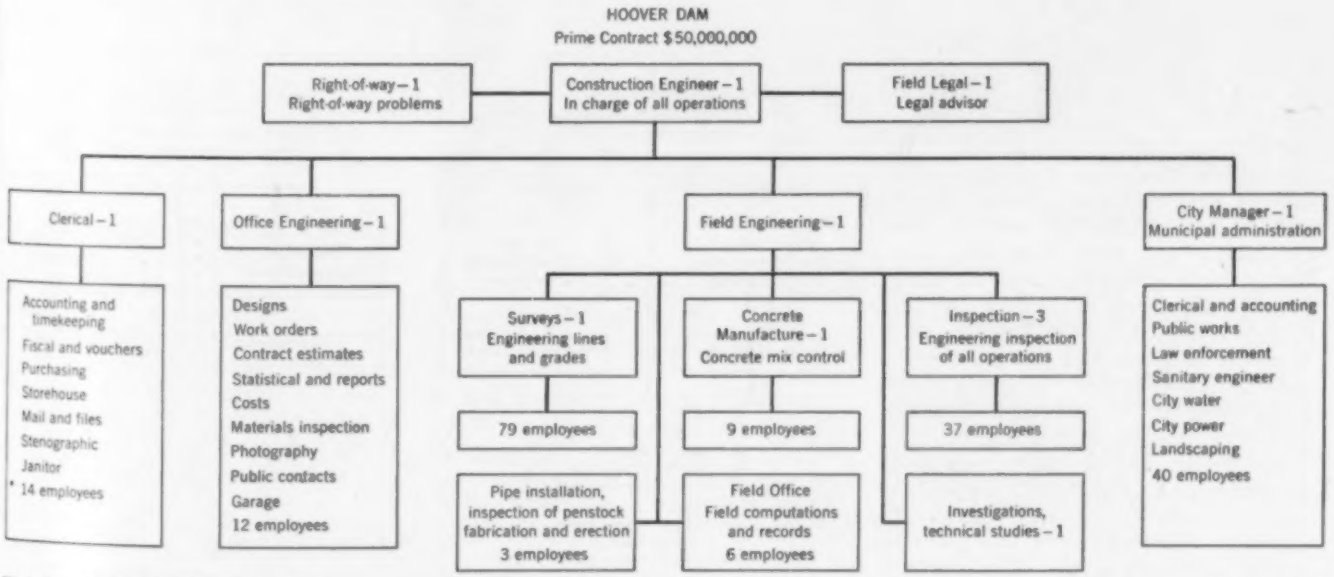
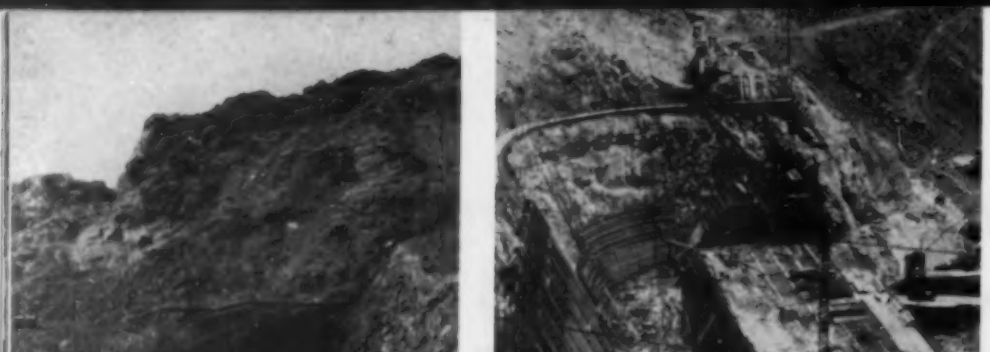


FIG. 1. ORGANIZATION CHART prepared by Construction Engineer for Hoover Dam outlines staff arrangement for large federal job to guard interests of awarding agency.



CONSTRUCTION ENGINEER should see that provisions for changes in plans and specifications are incorporated in contract in case of need to meet unforeseen conditions. Hoover Dam spillway was altered from original design by Order for Change to provide side channel spillway and inclined tunnel, here seen in two stages of construction.

all questions as to how the structure is to be built. Such drawings and specifications are included in, and become the principal part of, the contract. Hence it is essential that the drawings show clearly just what is desired in the structure. Likewise, the specifications must be couched in clear, definite language not easily confused as to meaning—in words of one syllable not needing a lawyer for interpretation.

5. To make sure that the specifications include any special conditions or requirements not specifically mentioned in the contract or the drawings. For example, the camp site for the contractor, status of the required rights-of-way, and who secures the right to use facilities for the contractor's camp, for warehouse and working areas, water, means of transportation, light, power, mess houses, sleeping quarters, hospital services, police and guard personnel, schooling for the children of those in camp, recreation activities—all these matters must be clearly stated. In isolated locations, it may be necessary to provide stores, barber shops and all other necessary services for employees and their families. The better these services are and the more clearly they are explained in the specifications, the less turmoil and turnover in personnel will be experienced. Also better progress and lower costs will be realized if all these services are planned in advance.

6. To provide adequate inspection to insure good work and compliance with specifications and drawings. Adequate inspection is one of the major functions of the Construction Engineer and his staff, and on it may depend the safety and utility of the structure. The type of work involved, that is, whether excavation, concrete, or mechanical installations, will determine the type of organization and attention required.

7. To include in the contract wage rates and procedure for labor relations. In federal contracts, provisions must be included to meet the limitations of the 8-hour day and overtime law, also those of the Walsh-Healey and Bacon-Davis Acts. In this day of strong union organizations, similar provisions may be included in all contracts.

8. To include in the contract, if necessary, provisions for changes in the plans and specifications to meet unforeseen conditions developed as the work progresses and to make compensation therefor. Most contracts contain such provisions. The courts have ruled that payment cannot be allowed by the Construction Engineer in federal contracts for delays in completion beyond the contract date unless the delays are actually due to the acts of the contracting officer, the owner, or Acts of God. Changes in the project or the structure can only be made by an official order for changes which also specifies the basis of payment for such changes, and all changes must be within the legal framework of the original contract.

Likewise, extra work or miscellaneous jobs may be done by the contractor in response to an official order of the contracting officer or his representative (the Construction Engineer) if in accordance with the specifications, which usually contain a clause providing for extra work (not part of the contract) and provide the basis for payment. While the amount and scope of a single extra work order may be limited, the specifications may require that it be done on the basis of payment for actual cost plus a percentage for overhead.

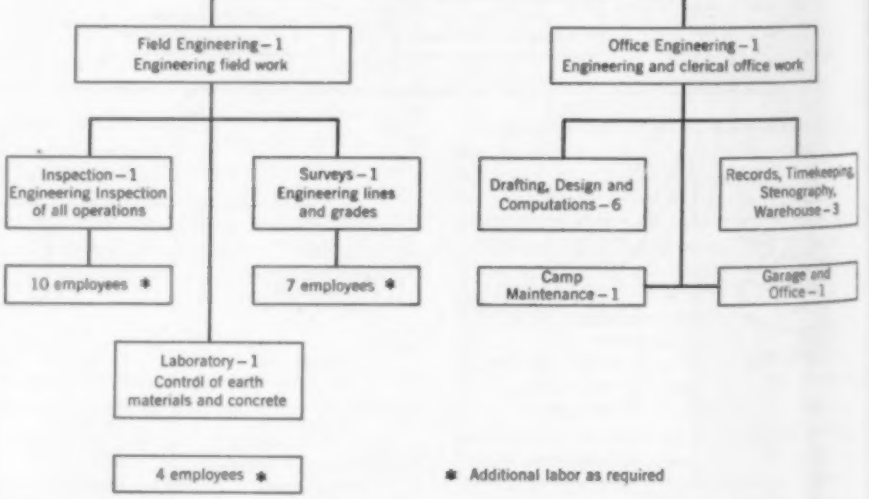
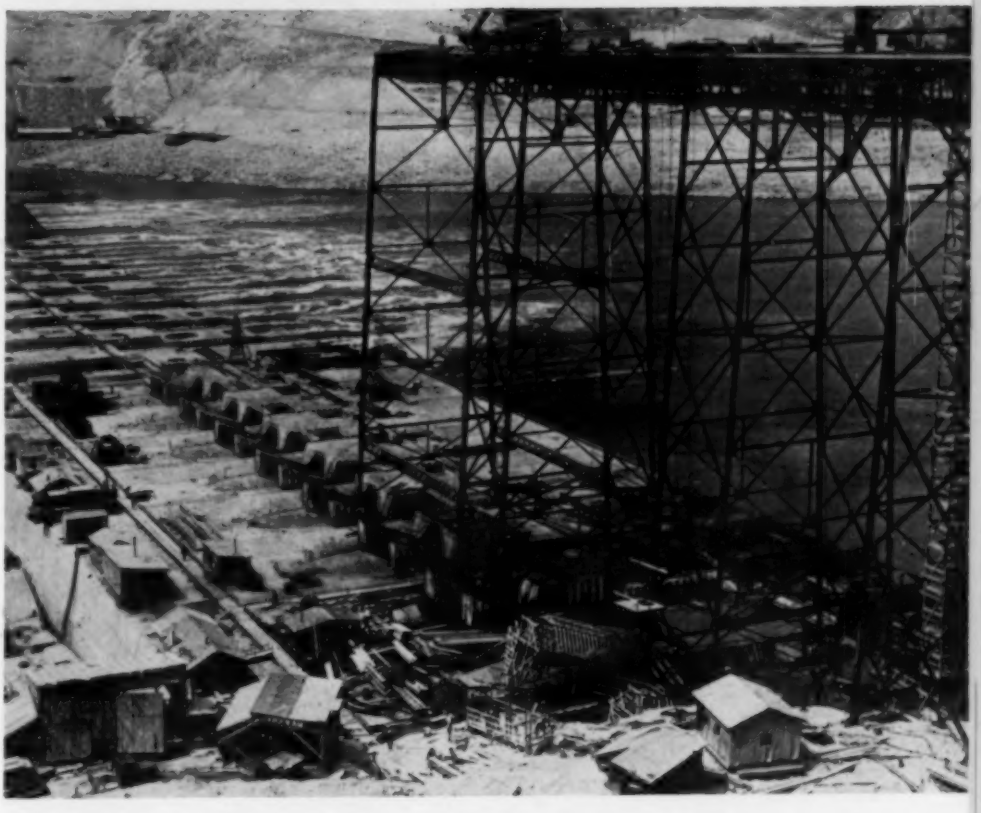

ENDERS DAM
(Prime Contract $5,000,000)
Construction Engineer – 1
In charge of all operations
Field Engineering – 1
Engineering field work
Office Engineering – 1
Engineering and clerical office work
Inspection – 1
Engineering Inspection of all operations
Surveys – 1
Engineering lines and grades
Drafting, Design and Computations – 6
Records, Timekeeping, Stenography, Warehouse – 3
10 employees *
7 employees *
Camp Maintenance – 1
Garage and Office – 1
Laboratory – 1
Control of earth materials and concrete
4 employees *
* Additional labor as required

FIG. 2. ORGANIZATION CHART for Enders Dam illustrates Construction Engineer's setup for smaller job, with fewer employees. Contracting agency is federal government.



CHANGES IN FEDERAL CONTRACTS can only be made by official Order for Change, which specifies basis for payment and which comes within framework of original contract. Order for Change may involve basic character of whole project, as in case of Grand Coulee Dam, where original plan contemplated relatively low dam for power only. Foundation for high dam (above, right) was placed by first contractor under Order for Change involving equivalent volume of concrete as in low dam originally contemplated. Work on second contract (below, right) started where first contract left off.

that is, labor, materials, use of equipment, plus part of bond, insurance, etc., not directly or definitely appurtenant to this particular job.

9. To make definite provision in the contract, if so desired, for the contractor to furnish certain specified equipment, or materials to become a permanent part of the finished job. Or the contractor may be required to unload, store, handle and fabricate materials to be a part of the finished structure although such materials may be furnished by the owner. Checking and inspection of these materials are the duty of the Construction Engineer or his staff, and accounting for their use by the contractor must be accurately maintained.

The Construction Engineer must be fully informed as to the progress of the contract work, particularly as to pay quantities of work performed, and for which the contractor is to receive current partial payments under the contract. Quantities must be measured and payment to the contractor computed periodically with the specified hold-back as contemplated by the contract. The initiation of work on the job is largely the duty of the Construction Engineer by his staking of location, survey controls, and other work.

Figures 1 and 2 show the government organization for Hoover Dam and for a recent smaller job, Enders Dam in the Missouri River Basin Project.

Superintendent Is Other Half of Team

The engineer employed by the contractor is the other half of the team, which, with the Construction Engineer, is responsible for performing the work. When the award is made to his principal, the contractor's engineer, or Superintendent, immediately succeeds to a very important function. In fact, he should examine the site carefully and decide in his own mind how the job should be performed, what equipment will be required and the methods to be adopted. He should establish, as well as data will permit, the work schedule to be followed to complete the job on the contract dates.

The contractor's engineer should participate actively in the preparation of the bid so that he will know the plans for the work and the policies of his principals as to financing, bonds, insurance, compensation, safety, etc. This knowledge permits him to proceed in accordance with established policies and to give due weight to their effects on his programs and progress.

With this knowledge the Superintendent can proceed as soon as the contract is signed to recruit the key men needed to build the camp and to provide all such facilities as housing, warehouses, transportation, machine shops, mess houses, medical service—in fact all the things that make up a town of the size needed by his organization. Often such facilities should be a joint venture with the Construction Engineer to avoid duplication and reduce costs of construction and maintenance.

TRANSPORTATION SYSTEM for building of Davis Dam on Colorado River includes railroad trestle on which gantry cranes can operate. In planning and construction of transportation facilities, cooperation between Construction Engineer and contractor's Superintendent can often avoid duplication and reduce costs.

As the job progresses, frequent and detailed inspection of all phases of the work is essential to settle uncertainties among the force and to push all the scattered jobs. This attention encourages action and cooperative effort on all parts of the work in the field, design, office and accounts sections and thus prevents delay and ill feeling between various parts of the organization.

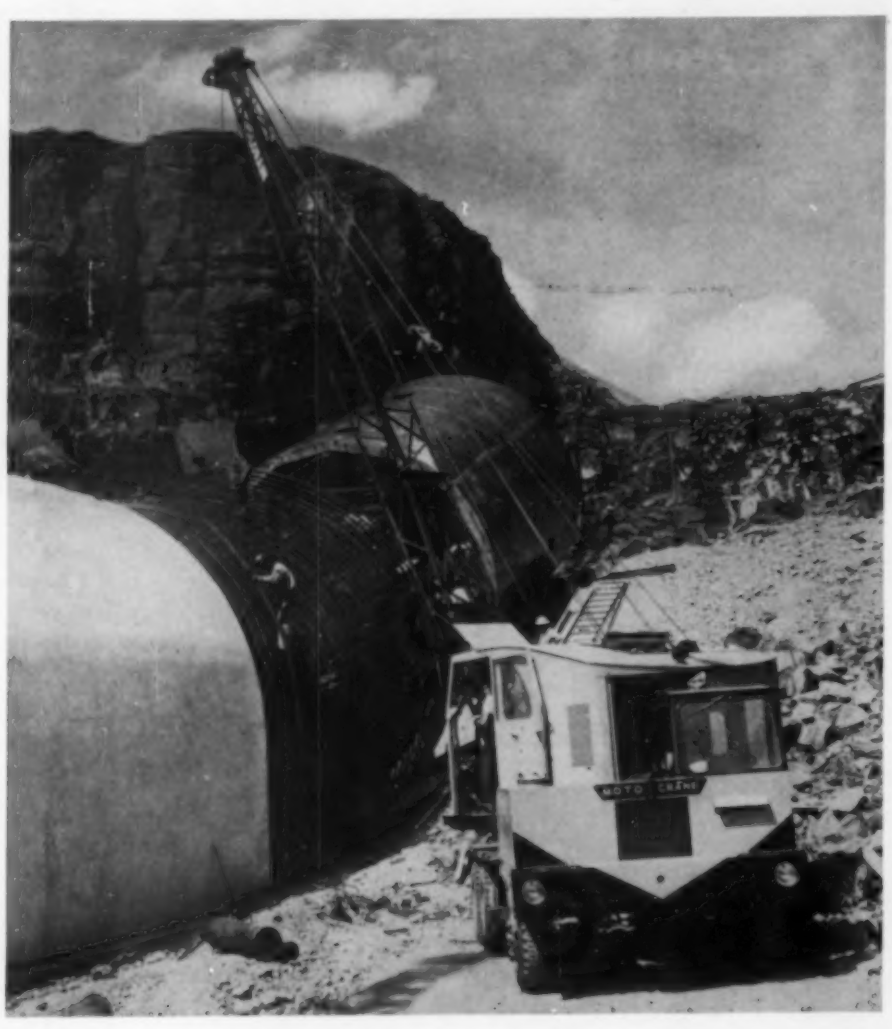
Constant contact with the Construction Engineer or his forces is essential to insure agreement on methods, inspection and particularly on the measurement of pay quantities to insure proper payments for the work performed. Continual study of plans is desirable to suggest improvements or errors in the plans and insure the main objective of both the owner and the contractor which is, of course, a permanent, safe job well done, with a reasonable profit, all completed to the satisfaction of both parties in a minimum time.

Some Sources of Difficulty

It is strange how often feelings of animosity can be generated between Construction Engineers and Superintendents even though both recognize that they are in a sense partners in the undertaking. Ill feeling can be brought about by the acceptance of an unbalanced bid for a contract. An outstanding example of such unbalance without bad feeling in the writer's experience is the case of Shasta Dam in California where on the basis of estimated quantities of excavation the lower bidder bid a price of $4.00 per cu yd and the second bidder $2.50 per cu yd for the same work. As the work progressed the rock proved worse than anticipated and finally the low bidder to whom the contract was awarded actually earned about 2 million dollars more than would have gone to the second bidder when all measurements were completed. Rejection of the bid and readvertisement were seriously considered because of the unbalancing in this case.

Another example of unusual procedure occurred at Grand Coulee Dam where the first contract was for the construction of a relatively low dam for power only. After further consideration it seemed unwise to build such a dam since it would not serve as the major structure of the Columbia Basin Project. As a result, an Order for Change was issued requiring the contractor to prepare

(*Continued on page 88*)



ONE OF MAJOR FUNCTIONS of Construction Engineer and his staff is to provide adequate inspection to insure good workmanship and compliance with specifications and drawings. On such inspection may depend safety and utility of structure. In photo, mobile crane aids in placing reinforcing steel for upstream elbow section of Bacon Siphon, part of Columbia Basin Project.

Construction Industry Aid

Asked to Lower Costs Through Better Engineering Education

LOWER BUILDING COSTS through support of better construction engineering training by the construction industry were foreseen in papers presented at one of two sessions conducted by the Construction Division, with Prof. Elmer K. Timby, Princeton University, member of the Division's Executive Committee, presiding. Four papers supporting this theme were presented. Authors were: Prof. Morris I. Evinger of the University of Nebraska's Civil Engineering Department, "Construction Engineering Education—Present and Future"; H. W. Richardson, Executive Editor, *Construction Methods*, New York, and F. A. Nikirk, Hale Machinery Co., Albany, N.Y., "Teaching Aids for Construction Engineering Education"; John C. Page, Denver, former Commissioner, Bureau of Reclamation, "Construction Organization and Functions for Awarding Agency," which is printed elsewhere in this issue; and Robert W. Briggs, consulting engineer, New Rochelle, N.Y., "Construction Engineering—Organization and Improvement of Construction Enterprise from the Viewpoint of Contractor and Construction Engineer."

M. I. Evinger

Professor Evinger decried "the present serious lack of suitable textbooks and other forms of teaching aids for construction courses," although he noted a marked increase in the number of construction engineering courses being offered by American colleges. He attributed the increase to the many influences arising from "increased costs of materials, equipment, labor, and supervisory forces, which have combined in many ways to prompt the construction industry, including contracting and engineering organizations, to seek larger numbers of young engineers for construction engineering training and service."

Asserting that construction engineering has emerged as a recognized branch of civil engineering, Professor Evinger defined it as "the art and science of bringing together men, materials, machines, money and management to solve the problems met in the design, production, distribution and fabrication of materials and articles into buildings and engineering constructions for the use of man." He said the increased number of construction engineering courses constitute a challenge to the entire construction industry for a larger and more effective measure of interest, cooperation and support.

"Forms of assistance which may be supplied by individuals or organizations in the construction industry to colleges of engineering in support of construction engineering education," Professor Evinger said, "may be classified broadly in the following forms: Financial assistance, teaching services of lecturers, course subject matter and teaching aids, construction background and experience training, and reference publications such as manuals, technical reports, contract documents and exhibits. It is reasonably certain that if the initial forms of assistance provided prove to be educationally beneficial, further developments in cooperative undertakings between most of the construction agencies and organizations and the engineering colleges will follow in increasing measure and quality."

Rear Admiral Kirby Smith, Chairman, Construction Div.; Vice-President, Raymond Concrete Pile Co., New York

In tracing the increased cooperation of the construction industry in enhancing engineering education, Professor Evinger, who is chairman of the ASCE Committee on Construction Engineering Education, cited the following objectives of a recently organized joint committee of the American Society of Civil Engineers and the Associated General Contractors of America, which is studying problems of mutual concern in the public interest: "Construction courses in engineering colleges to train men for construction," "making work in construction and designing public works attractive to young engineers," and "design which can obtain maximum benefits from mechanized construction operations."

H. W. Richardson and F. A. Nikirk

"There has been a wealth of experience gained in the construction industry but much of it remains in the hands of the individuals or groups who have gained proficiency in one or more operations or phases of the industry," said the authors. The basic principles and the fundamental theories underlying economical construction practices, as derived directly from that field of experience, must first be established. Then and only then may we expect the regular teaching staff of a typical engineering college to present a course in a scientific manner."

After this has been done the authors believe that maximum use can be obtained from available teaching aids such as technical articles in scientific publications and trade magazines, lectures by specialists, and promotional releases by manufacturers and trade associations. They believe that these releases generally have a scientific background and contain many practical aids of great value to those engaged in construction work and therefore to students. "The number of releases is rapidly increasing but many instructors are unwilling or unable to judge the value of the data, statistics or theories presented," they stated.

"It would therefore appear to be desirable that a central clearing house be established to which the various colleges could contribute and from which they could draw lists, classifications, and ratings of teaching aids as they become established." The authors suggest that one of the major 1949 functions of the Construction Division's Committee on Construction Engineering Education should be the gathering and dissemination of information concerning teaching material.

Robert W. Briggs

After tracing the procedure the contractor's engineer follows in estimating and bidding on a job, Mr. Briggs explained how a construction job is organized and financed by the contractor to whom the contract is awarded. He recommends that more attention be given in engineering college courses to contract construction procedure and presented for dis-

cussion detailed curricula to accomplish it.

"Construction engineering training for engineers in charge, for owners, of private and public construction would result in less working at cross purposes by contractors' and owners' engineers, would secure better work, and unquestionably lower costs," Mr. Briggs declared.

"Economy and practicality of design may be expected of the designer who has a working knowledge of construction methods and costs," he said. "It therefore appears that construction engineering education should be encouraged and promoted in every possible way through cooperation of contractors and the engineering profession, as well as the engineering schools."

Authorities Predict

No Decline in Construction Volume During 1949

"CONSTRUCTION Prospects for 1949" was the theme of the second session, at which Professor Timby led off with a definition of the subject, and important predictions were made by Charles B. Spencer, President, Spencer, White & Prentis, N.Y., "Private Construction"; W. E. Reynolds, Commissioner of Public Buildings, Washington, D.C., "Public Construction"; Kirby Smith, Vice-President, Raymond Concrete Pile Co., New York, "Foreign Construction"; M. H. Baker, National Gypsum Co., "Materials of Construction"; Prof. David A. McCabe of Princeton University's Department of Economics, "Labor"; and A. H. Ayers, Utah Construction Co., San Francisco, "Equipment." A summary, under the subtitle, "Planning to Be Done," was presented by Waldo G. Bowman, Editor, *Engineering News-Record*, N.Y.

Charles B. Spencer

In discussing prospects for private construction during 1949, Mr. Spencer said, "The same influences working to accelerate building construction last year are still present." Unsatisfied housing, a higher than prewar birth rate, ambitious industrial plans for expansion, and demands for department-store modernization are among the influences. "Steel and electric power production are setting new records every month."

Against "this never satisfied demand for construction," Mr. Spencer pointed to the decline in construction of small speculative suburban housing and to psychological factors such as the knowledge of recessions already taking place in other lines that "might tend to decrease building as well as other expansion."

"It is my personal feeling that our industry will be the last to be readjusted, and that the extent of the readjustment will be less than almost anywhere else in our economy," he predicted, because "there is a larger backlog in construction than in any other industry." Emphasis is swinging back to public and commercial building rather than industrial building." He said that there is no slump in sight—but there is a swing toward a buyers' market that will be good for our national economy.

W. E. Reynolds

"Deferment has been the persistent keynote in public construction policy since 1940," Mr. Reynolds pointed out in his paper delivered by H. H. Jewell, but "there are limits beyond which deferment is no longer possible." He predicted that the put-in-place volume of public construction, increasing in 1949 over 1948 by close to 25 percent, will approach $5 billion. "Of this, probably one-third will be federally financed, with the remaining two-thirds financed by state and local governments." He predicts that highway construction will account for $1\frac{3}{4}$ billions of the total, with increases over 1948 in construction of schools, hospitals, conservation and development works, and water supplies and sewage disposal facilities.

Pointing out uncertainties in labor and materials, Mr. Reynolds expects for 1949 a total national construction expenditure, both public and private, of $18\frac{1}{4}$ billions. This is a little more money than was spent in 1948 but it will buy in 1949 about the same volume of building as in 1948. He warned that the construction industry must devote its best energies to "a real decrease in construction costs" in order "to meet the customer's ability to pay." He believes that only by reducing costs can the vast market available to the construction industry be tapped.

Kirby Smith

"Public programs, industrial construction, and rebuilding of transportation systems and utilities all go on at a great pace on every continent," Mr. Smith averred. "The tempo of construction abroad is very definitely stepping up. Everywhere there is a feeling of urgency born of the setback suffered almost universally in construction during the war years."

Although Mr. Smith was unable to obtain reliable figures of the dollar volume of construction projects abroad, either through the World Bank, international trade organizations or the Economic Cooperation Administration, he needed only to name a few projects by type to indicate the magnitude of construction abroad.

"Dams, hydroelectric plants, and irrigation projects seem to be using one-third of public funds and labor."

France:
- **Genissiat Dam, upper Rhone River, largest concrete dam in western Europe, completed last year**
- **Chastang Dam, Dordogne River, under construction**
- **Castillon Dam, Verdon River, under construction**
- **Power dam on Durance River, 250 ft high, in design stage**

Germany:
- **Diversion of Rissbach into Walchensee, Bavarian Alps, to increase yearly output from 120 million kwhr to 210 million kwhr**

Australia:
- **Kiewa Dam, in Victoria, a one-million-kwhr power project, $83 million**
- **Irrigation works on Glenelg and Loddon Rivers, $20 million**

India:
- **A dozen river projects launched, among them:**
  - **Damodar Valley Project, $165 million**
  - **Godaveri River Dam, $257 million**
  - **Bhakra Dam, $209 million**
  - **Rihand Dam project, to irrigate 4 million acres**

Central Africa:
- **One hydroelectric project planned for 1953 completion will develop 524 million kwhr annually**
- **Lake Victoria Falls, potential power estimated at 922 billion kwhr annually**

"Communication lines also take a

top-priority position in foreign construction," Mr. Smith declared.

Calcutta has a $150 million electric railway under construction.
Italy, 20 percent of ERP counterpart funds, for rail and road reconstruction.
Rome, a subway authorized for 1950 completion.
France rebuilt 1,850 bridges and 65 tunnels in first three postwar years.
Germany, repairing autobahn structures.
Brazil seeks $1 billion U.S. private loans for railroad work.
Argentina in 1948 appropriated $400 million for rolling stock and shop construction.

"International airports are a paramount need to increase world trade in such widely separated places as Italy, Puerto Rico, Turkey and Tasmania." The ports of Melbourne, Madras, Sydney, Maracaibo, Monrovia, Rio de Janeiro, Calcutta and Whampoo are but a few of the world's seaports under repair or enlargement."

"Economic Cooperation Administration will get $1\frac{1}{2}$ billion required to finish out the present fiscal year," Mr. Smith believes, "and another $4 billion for the fiscal year of 1950. Outside of ERP, other loan agencies will be sought out by Latin American and other nations. The cold war will continue, but I believe construction will flourish in spite of it."

Melvin H. Baker

A 5- to 10-percent decrease in the volume of construction from last year's all-time high, resulting in stabilization or even reduction of building costs, was forecast by Mr. Baker. Increased availability of labor and the tendency among contractors to use more modern methods, machines and materials were cited as factors which will cut into costs.

"The output of most materials has been increasing steadily since the close of the war," Mr. Baker said, estimating the 1948 production at 5 percent higher than that of 1947, in which was "recorded the highest output of any year since 1915."

He attributed the 117-percent increase in the composite price of all construction materials in June 1948 over the composite price in 1939 to the "record-breaking demand and the impact of postwar inflationary forces."

New and improved products which he said are designed to bring about more efficient building and reduce costs were listed by Mr. Baker as follows: Ready-mixed concrete, light-weight aggregates, prefinished flooring and availability in modular sizes of such materials as brick, tile, wood and metal sash and doors, wallboard and rock-wool insulation.

"As materials become more abundant during 1949," he said, "the effect of these improvements and of others still to come will become more and more evident. It will become clear that the materials industry, by greatly increased capacity, by the diversion of millions of dollars to research for better quality and the lowering of costs, is doing a tremendous job to maintain a high level of construction. To house our people properly, construction must continue for the next several years at levels even higher than the 18-billion-dollar record for last year. Except for shortages of materials and labor required in the plants, mines and forests, the materials end of construction is now ready to meet almost any situation you may require."

David A. McCabe

Speaking of labor prospects for 1949, Professor McCabe said, "There are some uncertainties in the labor situation generally. One of these is whether there will be crippling strikes over the question of wage increases. Just now there appears little uncertainty that there will be demands for wage increases."

Quite apart from the cost-of-living argument, he believes that demands for wage increases will be based upon the right to share in the fruits of increased productivity. "Increased profits of industrial corporations are as potent a source of wage demands as rising living costs," stated Professor McCabe. While he is of the opinion that the wage issue can be settled without recourse to strikes, Professor McCabe is certain that a great deal depends upon the attitude with which the big corporations and the big unions enter the negotiations. "If either side thinks it has to teach the other a lesson, there will probably be trouble."

"Another source of uncertainty is what form the new labor law will take. Certain ineptitudes of the Taft-Hartley Law can well be spared," he believes. One of these ineptitudes is the attempt to establish a 30-day delay in the contract requirements to join the union as a principle. Another is the present prohibition of "jurisdictional strikes." On the other side, he asked, "If freedom to strike over jurisdictional questions is restored does anyone doubt that there will be more interruptions of production on this issue?"

A. H. Ayres

"A careful analysis of construction operations will indicate that each year equipment becomes an increasingly important element," said Mr. Ayres. "For the past seven years, equipment or its lack, has produced some major headaches for the construction operator." Today he makes his choices from fairly complete lines in almost every direction in which his needs may lead him."

"Equipment manufacturers are once more working for greater speeds, capacities and efficiencies; but they are not yet offering price reductions as an incentive to purchase for replacement of older equipment. Few items have been radically changed, but manufacturers are making the attempt to take the bugs out of lines already developed to simplify them or make them more effective.

"To increase over-all drilling speed, the conventionally sharpened drill steel is giving way to tungsten carbide inserts in the drilling faces of detachable bits. From another approach has come the low-cost throw-away bit intended to be used for one run of drilling and then discarded. Loss of time in changing drill steel has been materially reduced by using longer drill shells, particularly on drifter drills in rock tunnels."

For both on- and off-highway use, he stated that construction men are continually belaboring truck manufacturers for units with more weight capacity, more speed, and more power. Bottom-dump trucks of 25 to 30-cu yd capacity are available for placing earth and rock in highways, dams and airports at tremendous rates per day and per truck. End-dump trucks up to 25-cu yd capacity at speeds of 30 to 40 miles per hour are now available.

"Two of the larger shovel manufacturers have this year completely overhauled their lines of large dragline excavators, and can now provide the construction operator with units of 7 to 25-cu yd bucket capacity, and corresponding lengths of boom up to 250 ft.

"Deliveries of equipment are extremely variable, largely in proportion to the degree to which they can be produced by assembly-line methods," Mr. Ayres stated. "Even with these uncertainties, it is still possible to equip a heavy construction job of moderate size with new, or good-quality used equipment in a period of two to four months." He finds that costs of equipment of all kinds have been on steadily increasing levels since the war, with increases from 1946 to late 1948 varying from 20 percent for trucks to 50 percent for diesel-powered shovels and graders.

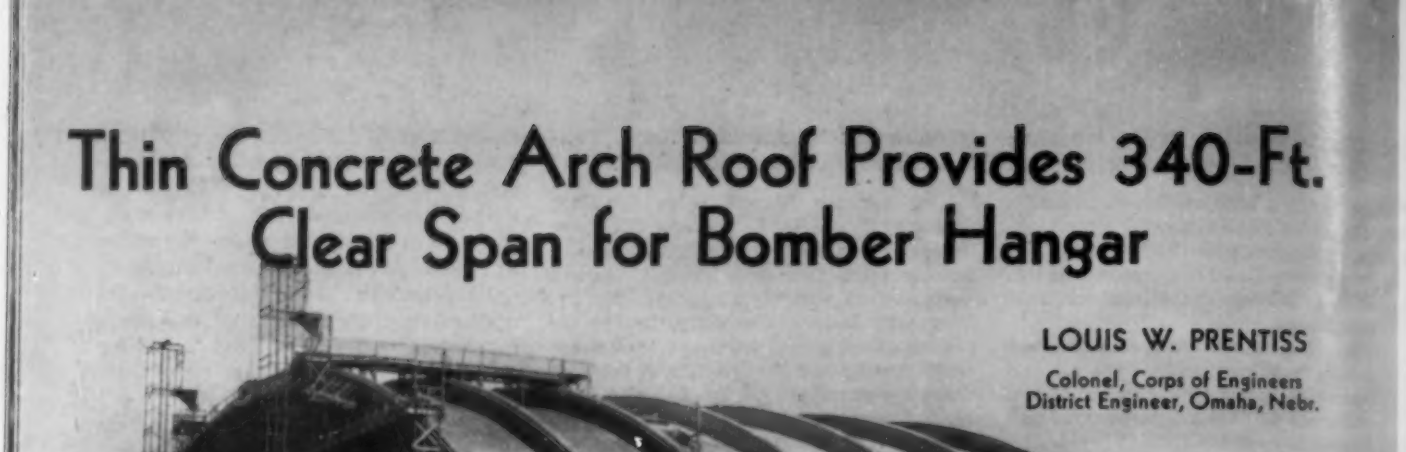
Waldo G. Bowman

Summarizing the predictions of the authorities on prospects for construction in 1949, Mr. Bowman

(*Continued on page 99*)

Thin Concrete Arch Roof Provides 340-Ft. Clear Span for Bomber Hangar

LOUIS W. PRENTISS
Colonel, Corps of Engineers
District Engineer, Omaha, Nebr.



COMPLETED HALF OF HANGAR for large bombers at Rapid City, S.Dak., is made up of three 50-ft-wide monolithic arch sections, each composed of two ribs and two intervening sections of thin concrete slab. Slab ranges in thickness from 7 in. at springing line to 5 in. at crown. Finished hangar will be 340 × 300 ft.

THE HUGE MONOLITHIC concrete hangar now under construction at the Rapid City, S.Dak., Air Force Base is one of two of its size and type now being built by the Corps of Engineers. Its twin is nearing completion at Limestone, Me. After a thorough review of more conventional types of construction, the concrete arch design was selected as best meeting the Air Force requirements for a 300×340-ft clear floor space. The present $1,673,716.44 contract is scheduled for completion June 1, 1949.

MOST UNUSUAL DESIGN FEATURE of the hangar now under construction by the Corps of Engineers at Rapid City, S.Dak., Air Force Base, is the concrete roof. This thin cylindrical shell is only 5 in. thick at the crown of the arch and 7 in. thick at the springing line although it has a clear span of 340 ft between supporting columns and a maximum vertical clearance of 90 ft.

Rigidity in the structure is provided by external arched rib supports, 20 in. thick and 5 ft in height, spaced 25 ft on centers. The structure provides adequate space for the simultaneous repair of two B-36 or six B-29 bombers and includes provisions for shops, spare-parts storage, and offices for a tactical bomb group. This concentration of facilities will permit coordination of work and promote efficiency.

For construction purposes the roof is divided into six 50-ft sections each containing about 600 cu yd of concrete which is placed monolithically. Each section weighs almost 1,200 tons, causing a dead-load thrust of about 750 tons on the columns at the springing line. Over-all hangar dimensions are 314½ ft long, 369 ft wide and 95 ft high.

Design Introduced in 1934

The design was prepared by the firm of Roberts & Schaeffer of Chicago, which was employed as architect-engineer. The hangar is being built by the Steenberg Construction Co. of St. Paul, Minn., under the supervision of the District Engineer, Omaha District, Missouri River Division, Corps of Engineers. Administration and inspection in the field are accomplished for the Corps of Engineers by one officer and six civilian engineers and inspectors. The architect-engineer also has a field representative at the site for consultation on certain phases of construction peculiar to the design, such as placing of concrete for monolithic roof sections and decentering.

This type of monolithic roof design, known as the Z-D system, was introduced in the United States in 1934 by Roberts & Schaefer Co. Since that time the firm has designed a similar hangar at Limestone, Me., and many smaller structures of this type including Navy hangars at San Diego, Calif., and the Hershey (Pa.) Sports Arena.

Advantages of Design

Some of the advantages of this type of hangar are stability when subjected to bomb or earthquake shocks; fireproof construction; low initial cost and low maintenance costs; a wide, clear span with no inside bracing; adequate height of opening to clear the tail of a B-36 bomber, which is almost 60 ft high; and adaptability for maintenance or storage of a number of smaller planes. Another advantage is added economy if a number of identical buildings are to be constructed at the same location, since the centering and roof forms, which alone cost more than $100,000,

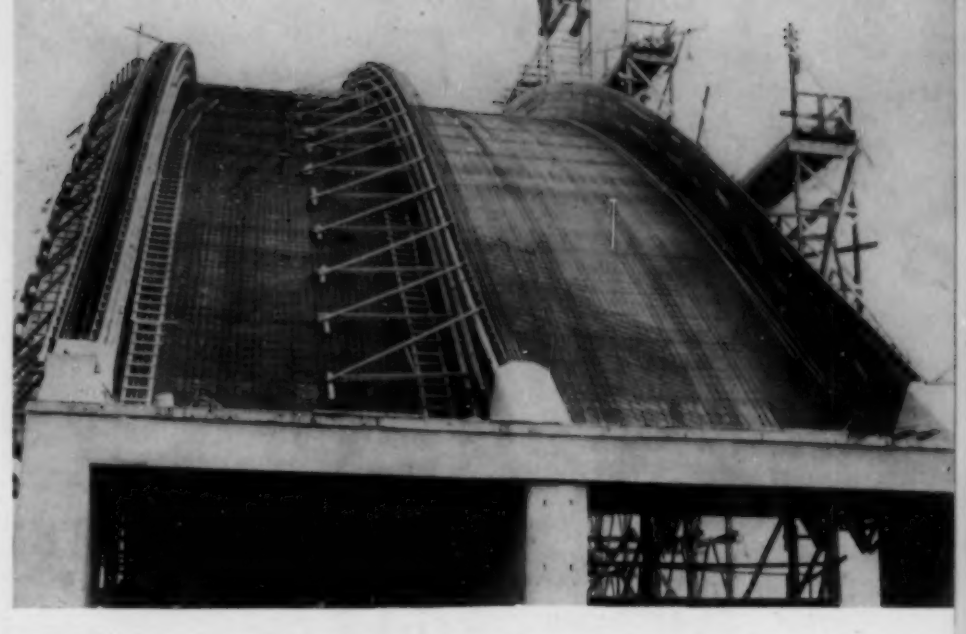
can be reused, and personnel can be utilized more efficiently. Still other advantages are the maximum utilization of locally available materials and labor and the holding to a minimum of skilled labor and critical materials.

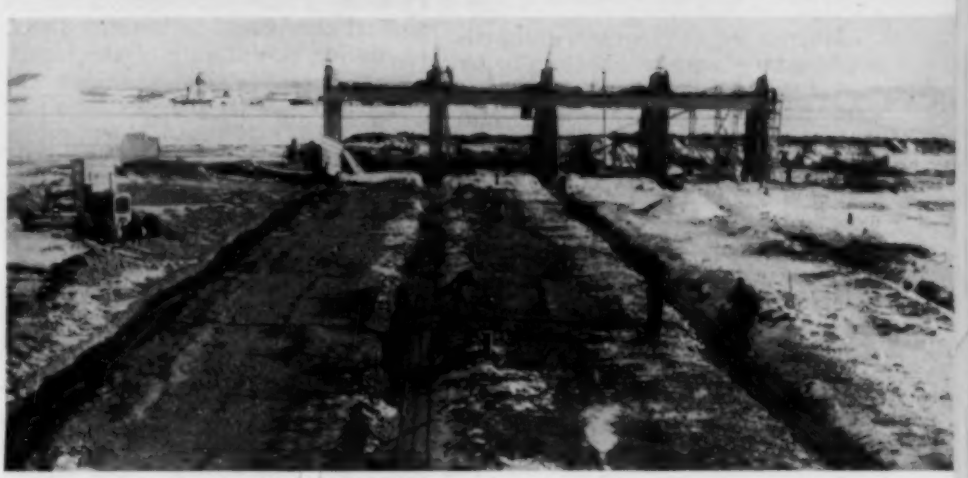
Concurrently with the preparation of plans and specifications, engineering studies were initiated to adapt the Roberts & Schaeffer design to local conditions. Test borings were made for each footing. Samples of concrete aggregates were tested in the Missouri River Division Laboratory and at the Vicksburg Waterways Experiment Station. Samples of subgrade materials were tested to determine acceptability and best methods of compaction. Scale models were constructed of the roof, columns and footings for a detailed study of stresses due to dead load, wind and snow loads. As much information as possible was compiled on weather conditions, labor, concrete aggregates and all other factors which might influence actual construction.

Construction Scheduled to Save Time

Under ideal conditions, construction should be accomplished in the following order: (1) Footings; (2) subgrade; (3) columns, lean-to roofs and beams up to the springing line of roof sections; (4) roof sections; (5) grade beams, door tracks, floor, walls and bracing, boiler house; (6) structural steel, hangar doors, siding, insulation and roofing. Construction of movable centering and roof forms should be done concurrently with Step 3. By the time the last footings are completed, the first roof section should be placed. Every effort should be made to have as many phases of construction as possible under way at one time. Since construction could not be started until early fall, the contractor's schedule of operations did not conform completely to the ideal sequence of work.

For any structure of this magnitude, one of the primary problems is to obtain a suitable foundation. In early plans, developed before complete soil data could be obtained, spread footings, stepped on the bottom to develop extra friction with the subsoil, were considered, to be used without tension ties. However, the soil profiles revealed several layers of sand and gravel separated by soft layers with a high clay content. Shale was encountered from 12 to 25 ft below the surface throughout the area. When laboratory tests indicated the possibility of excessive shearing movements in the layers of soft clay, it was decided that spread footings would not be adequate since excessive differential movement or rotation of any of the footings could set up high stresses in the roof.





MONOLITHIC SECTION of hangar roof, consisting of two ribs and intervening thin slab, is poured and decentered as unit. Each pair of columns which take thrust of arch rib are tied together at base by six nickel steel tension tie-rods placed in trench between columns and prestressed to extent of dead-load thrust. In lower photo, three of six tension tie-rods are in place for three pairs of columns in first monolithic arch section. In top photo, reinforcing steel is being placed prior to pouring of first roof section.

Tension Tie-Rods Take Arch Thrust

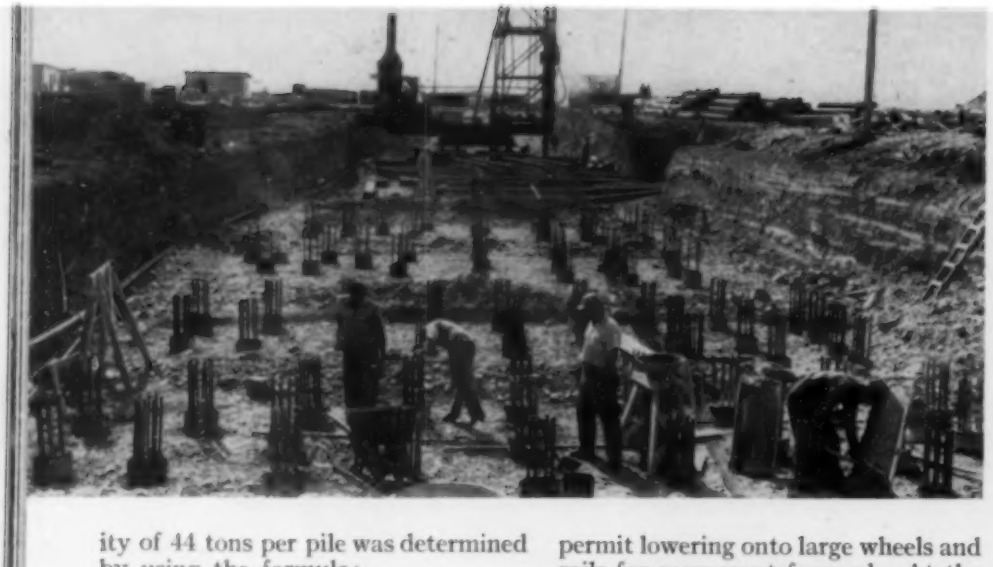
The revised design called for 616 concrete piles to be placed under the footings, which were considerably reduced in size. Seventy-eight $2^1/_2$-in. nickel-steel tension tie-rods, six to each arch rib, take the horizontal arch thrust. These were placed in trenches between the columns of each arch rib and required relocation of electrical conduits, plumbing and heating pipes. The placing of the tension tie-rods also created an additional problem in connection with subgrade compaction.

The Raymond concrete piles used vary in length from 12 to 24 ft and are reinforced with cages of reinforcing steel for at least 8 ft down from the top of each pile. Piles are designed for a minimum bearing value of 44 tons each and to take the horizontal thrust on the structure due to wind and snow loads.

For each line of footings, a trench was excavated to an average depth of 10 ft. Heavy timbers were laid longitudinally in the trench and the timber pile rig was skidded along on rollers. First, one pile was driven in each end of each footing while a complete log was kept of the number of blows per foot. These records were then compared with the soil profile for each footing to make sure that all layers of soft material had been passed through. From this information an average length of piling was determined for the individual footing which was a minimum for the remainder of the piles in the footing. Piles in the footings averaged 18 ft in length. The minimum bearing capac-

mote efficiency.

accomplished for the Corps of Engi- which alone cost more than $100,000.



PILE CASINGS for each line of arch footings are driven in trench 45 ft wide, 340 ft long, excavated 10 ft deep. Casings are filled to grade with ready-mixed concrete transported to site in truck-type mixers. These Raymond Concrete piles are driven with Vulcan No. 1 steam hammer (background) weighing 6,500 lb, with normal stroke of 3 ft.

ity of 44 tons per pile was determined by using the formula:

$$P = \frac{2WH}{S + 0.1} \times \frac{1}{2{,}000}$$

Concrete for the footings and pedestals was placed monolithically by means of a Mixermobile and chutes, with four dry-batch trucks. Two electric vibrators were used for compacting the concrete. Membrane curing compound was applied to all exposed surfaces, except the tops of the pedestals, which were covered with damp sand. High early strength cement was used and the heat of hydration was such that no difficulty was encountered in keeping the 120-cu yd mass of concrete protected in temperatures as low as 20 deg F.

Columns, lean-to roofs, spandrel and edge member beams, and haunches for arched ribs were placed monolithically up to the springing line of the arched rib sections. The columns and haunches presented the greatest difficulties since there was a vertical distance of 21 ft from the top of the haunch to the base of the column and in no place in the column was there more space than 6 × 12 in. between reinforcing steel. Form ties made placing of tremies difficult. One oval-shaped tremie 6 × 12 in. was placed in the center of each column. Concrete was placed with a Link-Belt LS-85 Speeder crane with a 1-cu yd bucket. Windows were cut in the sides of the column forms for vibrating the concrete. Rubber mallets were also used on the column forms to eliminate honeycombing at the surface.

Building Arch Centering and Forms

As previously mentioned, concrete for the arched roof was divided into six large monoliths for placing, each 50 ft wide and 340 ft long, extending from haunch to haunch. Centering and forms for the first monolith were built in place. Wedges were placed under each post of the centering to permit lowering onto large wheels and rails for movement forward. At the tip of each post a small screw jack was placed as the support for the roof trusses. These jacks were arranged so that they could be lowered 3 to 5 in. during decentering of the forms. Dressed and matched sheathing was laid diagonally for the roof form and lined with masonite. Wire cables were placed as guys on each side of the scaffold.

Centering and roof forms were erected with a Monitowoc Speed Crane with a 100-ft boom. Structural members and braces were precut by Timber Structures, Inc. As much of the formwork as possible was prefabricated on the ground and then set in place with the crane. Roof trusses and the first 12-ft level at the base of the centering are of bolted and split-ring construction. The rest of the formwork is nailed.

As soon as the roof forms were set and aligned, two crews began to place reinforcing bars and wire mesh. Materials were hauled up the steep slopes of the forms by a small power-operated winch. In pulling the 60-ft-long reinforcing bars into place, a small sled was devised to support the leading ends of these $1^1/_4$-in. round bars.

Placing Concrete in Roof Sections

Concrete placement presented several problems. After considering several methods, the contractor finally elected to use two steel towers 120 ft high, each with a concrete hoist of 1-cu yd capacity, for raising the concrete to the roof sections. Concrete was dumped from each hoisting bucket into a hopper of 2-cu yd capacity, from which concrete buggies were loaded.

Concrete was placed in lifts varying from 15 in. to 6 ft, depending on placing conditions. Workmen moved the chutes for the roof-slab sections so that no concrete was placed at a distance greater than about 6 ft from the end of a chute. A flared section 10 ft long was used at the end of chutes for the roof slabs to save excessive handling of chutes. Placing started simultaneously at the springing line on each side of the arch and proceeded as uniformly as possible so that no unusual stresses would be placed on the forms.

Air Entrained Concrete Used

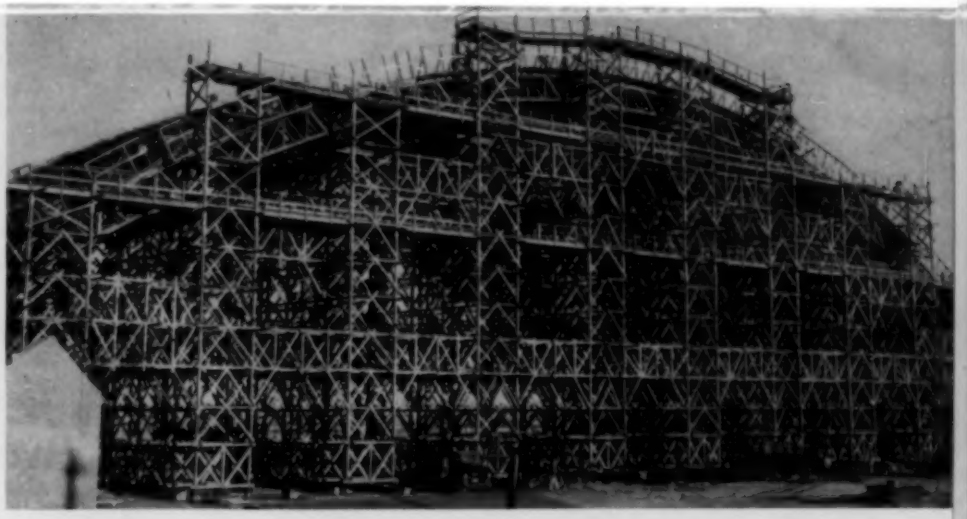
Concrete for roof sections varied in slump from 3 to 5 in. depending on placing conditions. Air to the amount of 4 percent was entrained and $6^1/_4$ sacks of cement were used per cubic yard. Minimum compressive strength of concrete was 3,750 psi at 28 days. The concrete batching plant consisted of a Butler 70-ton aggregate and sand plant and a 400-bbl Butler cement silo. Six transit-mix trucks on a 2-mile haul transported the concrete to the base of the towers. Two 12-hour shifts were used, and concrete placing work was started early in the evening.

Concrete for roof slabs was finished with hand floats and push brooms on the steeper slopes and almost exclusively with bull floats on the flatter slopes. No screeds were used. Finishers, working from floating scaffolds, were all equipped with depth gages and could also be guided by the fact that the top layer of reinforcing was supposed to be $^3/_4$ in. below the concrete surface. Tops of arched ribs were given a smooth steel-troweled finish. On all exposed surfaces, membrane curing compound was used—applied by one workman per crew, using a hand sprayer equipped with a nozzle extension. These men worked directly from the finishers' scaffolds.

Decentering of a completed roof section and moving the forms to the next section was found to be a relatively simple and quick operation, but required teamwork and careful planning. Decentering was not started until the job-cured cylinders attained a minimum compressive strength of 2,500 psi and beam tests indicated a minimum modulus of elasticity of 2,000,000 psi.

The architect-engineer's field representative computed the amount of vertical deflection anticipated at each of the 176 roof jacks for each stage in decentering. He also prepared a table of load increments to be applied in stressing the tension ties so that such

soft clay, it was decided that spread ing steel for at least 8 ft down from length. The minimum bearing capac-



LEADING EDGE OF SCAFFOLDING contains hoisting towers for raising concrete to three different levels on each side of arch. Withdrawal of wedges placed under posts of scaffolding permits lowering onto large wheels and rails for movement forward. Windstorm of August 13, 1948, completely demolished scaffold as well as centering and roof forms, causing loss of more than $100,000 and delay of about six months.

stressing would always be one increment ahead of the loading of the columns. The computed vertical deflections were based on the measured modulus of elasticity with tabulated corrections for temperature.

Decentering Calls for Teamwork

One man was assigned to each of the 22 rows of 8 jacks, and a foreman was designated to announce the number of quarter turns per jack, the row, and the jack to be turned. All turns were then made simultaneously. Another crew was designated to handle the three jacking frames and six jacks used to stress the tension tie-rods by jacking against the pedestals on one side of the building.

The amount of stress placed on the tie-rods per load increment was measured in three ways: (1) By measuring with a ruler the actual elongation of the rods; (2) by reading the gages on the jacks; and (3) by reading strain gages placed at three points along the rods and taking the average reading. The results obtained by all three methods were correlated. While stressing of the rods or lowering of the form jacks was in progress, continuous readings were taken on permanent markers on each column to insure that no vertical, horizontal or rotational movement of the structure occurred.

These operations were continued until all the tension tie-rods were completely stressed and the roof form was completely free from the concrete. Lowering of the lines of jacks under the roof slabs was always kept ahead of the lowering of the lines of jacks under the arch ribs. Jacks had to be lowered until the observed vertical deflection at the crown of the arched section was about $^{15}/_{16}$ in. before the forms were completely free.

The tension tie-rods extend through the footings and after prestressing are secured, in tension, by nuts bearing against steel plates embedded in the concrete on the outside of the footings.

After decentering was completed, the scaffold was moved 50 ft to the next location and the entire operation repeated. After the roof is completed, underside patching will be done from the scaffold, which will be pulled back through the hangar.

Floor Compacted and Concreted

Because of the heavy bomber loads to be carried, a strong floor is required. The concrete of the main hangar floor varies in thickness from 18 to 27 in. and rests on an 18-in. depth of 3-in. minus granular subgrade compacted in three 6-in. layers. No difficulty was encountered in getting 90 percent modified AASHO density on the bottom layer with a single-drum La Plante Choate sheepsfoot roller pulled by a Caterpillar tractor. The middle layer was compacted to 95 percent modified AASHO density by the same equipment in combination with rubber-tired rollers. For the top layer, 100-percent modified AASHO density was attained without difficulty using the same equipment as for the bottom layer, in combination with a 15-ton Austin, three-wheel, smooth steel roller. Pneumatic hand tampers were used in inaccessible areas such as around drains and tension tie-rods.

Floor drains are provided every 40 ft in both directions. Sixteen service pits, complete with air, water, electrical outlets and ground rods are spaced at intervals in the floor for convenience of maintenance personnel. All electrical outlets within 4 ft of floor level are explosion proof and weather tight. All construction is fireproof.

Both Radiant and Space Heating Provided

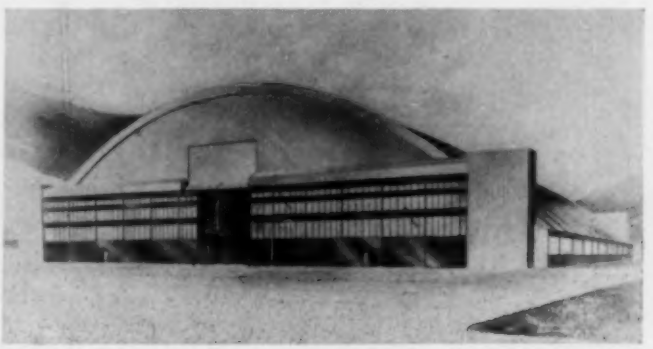
The heating system of the hangar consists of 95,000 lin ft of 2- and $1^1/_4$-in. pipe embedded in the floor, supplemented by a large unit space heater of 1,350,000-Btu-per-hour capacity at each of the four corners of the building. Radiators are provided for offices, shops and supply rooms.

Radiant heating pipes are installed 8 in. below the surface of the concrete throughout the main hangar floor and 2 in. below in the 5-in. slabs in offices, shops and spare-parts rooms. Radiant heating panels were designed to be perfectly level. For the main hangar floor the heating subcontractor devised a number of trusses which were set up above the floor surface and from which an angle-iron support was suspended at the correct elevatino to support the radiant heating pipe. This arrangement eliminated the danger that the pipe would be disturbed during placing of the concrete for the floor.

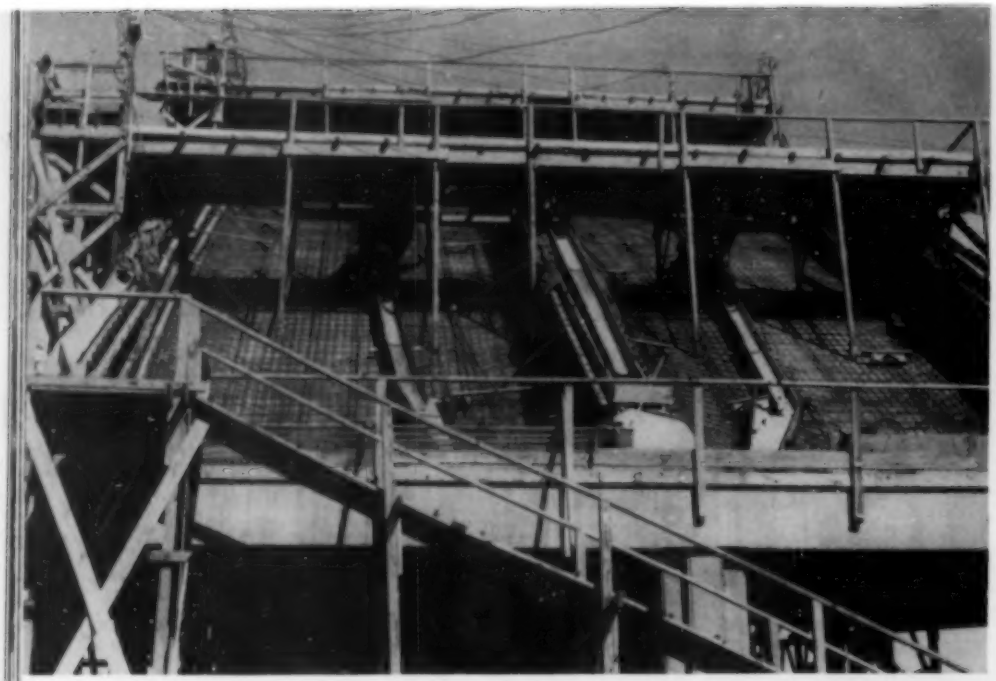
Placing Door Supports

For the door supports, structural steel was placed on the northeast end (the other end is not yet completed) with a Manitowoc Speed Crane and 100-ft boom. All connections of structural members are riveted, but the connections of the structural steel hangers to plates embedded in the arched ribs are welded.

All roofing for the hangar will be placed during the spring of 1949. Roof slabs and lean-to slabs will be



DOORS AT EACH END OF HANGAR permit entrance of B-36 bomber tails, which are nearly 60 ft high. Opening has total width of 300 ft 2 in. and height of 40 ft, with center tailgate door 51 ft 6 in. wide by 22 ft $6^1/_4$ in. high. Main door leaves are 25 ft wide.



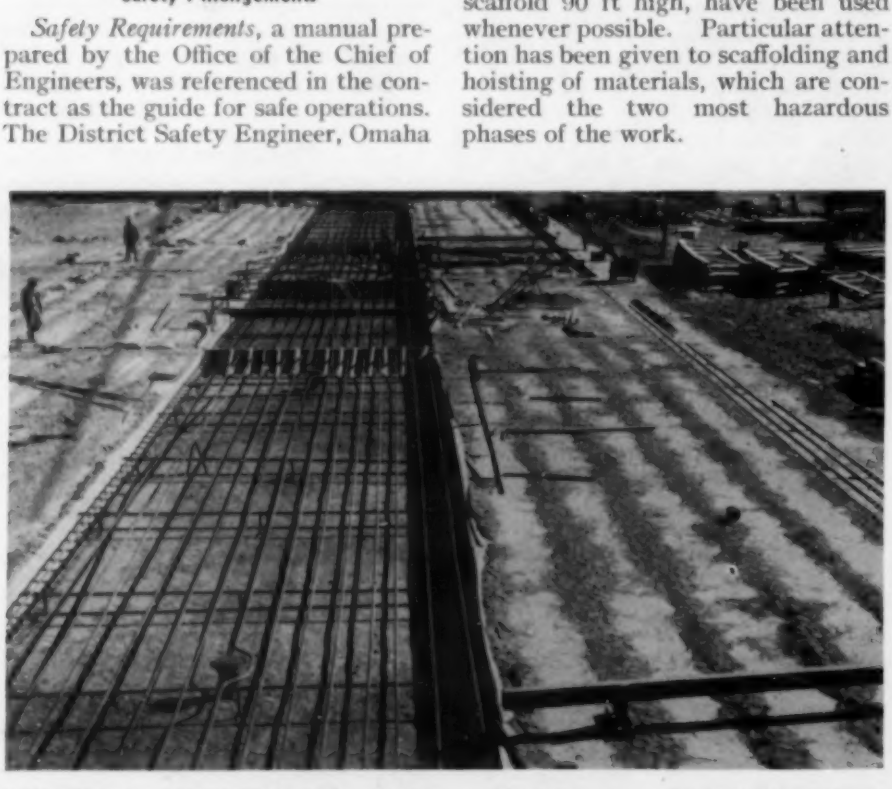
PREPARATIONS ARE COMPLETE for pouring second monolithic roof section, with hoist towers, walkways and chutes in place. Concrete buggies will move along runways extending out from towers at three elevations and discharge into half-circular chutes 16 in. wide. Chutes are in 10-ft sections and their length during pour is limited to 40 ft.

covered with 1 in. of granular surface insulation and a four-ply roof. Roofing asphalt with a melting point of not less than 180 deg F will be used on the arched roof; and on the flat lean-to roofs, coal-tar pitch of 140-deg melting point. Wood strips attached to the steep slopes of the arched roof will hold the insulation in place.

Safety Arrangements

Safety Requirements, a manual prepared by the Office of the Chief of Engineers, was referenced in the contract as the guide for safe operations. The District Safety Engineer, Omaha Engineer District, made a special study of all phases of construction of the hangar and prepared an "Advance Safety Plan," which has been used in the field extensively to enable the contractor to make necessary arrangements in advance for safety materials and equipment.

Prefabricated metal scaffolds of all types, including a movable Safeway scaffold 90 ft high, have been used whenever possible. Particular attention has been given to scaffolding and hoisting of materials, which are considered the two most hazardous phases of the work.



PLACING OF RADIANT HEATING PIPE in hangar floor follows compaction of subgrade and is followed in turn by placement of reinforcing steel for concrete floor. Throughout main hangar floor, heating pipe is installed 8 in. below surface of concrete, which varies in thickness from 18 to 27 in. Floor drains are provided every 40 ft in both directions.

For night work the contractor has provided excellent lighting, which is very important during placing of concrete for roof sections. Hazardous areas are kept roped off and appropriate warning signs are displayed. During placing of concrete a fire truck with a 500-gpm pump stands by. Fire extinguishers, barrels and buckets have also been provided. Two small fires have occurred since the start of the project, either one of which might have done serious damage if it had not been promptly extinguished.

Windstorm Demolishes Centering

The third roof section was placed August 3–4 and decentered August 11, 1948. Before further sections could be placed, a severe windstorm on August 13 completely demolished the huge centering and roof forms. Steps were immediately taken to effect replacement, but this work was not completed until December 1948. The contractor plans to place the remaining three roof sections in February, March and April 1949, about six months later than originally planned.

To provide necessary protection during the placing of the last three roof sections, the roof forms will be completely housed under canvas and enough warm-air heating will be provided to maintain the surface temperature of the concrete above 50 deg for at least 24 hours after placement. Humidity control will also be provided. The worst weather condition assumed is a 40-mph wind at minus 20 deg F. Heat will be supplied until after decentering and will then be gradually reduced until the form is moved to the next location. Most of the temporary heating system required for this purpose has been improvised from the equipment which will form part of the permanent heating system of the hangar.

Labor Requirements Vary

The average number of men employed in all trades has varied from 50 to 100 daily, but when concrete is being placed for roof sections, the labor requirements rise sharply. Approximately 80 skilled workmen and 120 common laborers are required to work one 10- to 12-hour shift each. The extra workmen, being imported from large cities, do not have the advantage of previous experience in the work.

In spite of labor shortages and inevitable lost time due to adverse weather, the contractor expects to complete the contract by June 1, 1949.

Chimney Specially Designed to Serve Hangar Heating System

HAROLD B. SCHNEIDER
Assistant Chief Engineer, Alphons Custodis Chimney Construction Co., New York, N.Y.

EXACTING REQUIREMENTS were met in the design and construction of the radial brick chimney built to serve the heating boilers for the U.S. Army Airfield hangar at Rapid City, S. Dak. (The hangar construction is described by Col. Louis W. Prentiss in the preceding article.) To avoid danger to aircraft using the hangar the height of the chimney was limited to 90 ft 0 in., just 5 ft less than the over-all hangar height. It was found more efficient to combine the foundation for the 105-ton chimney with one of the arch footings of the hangar.

Twenty-three working days were required for construction of the chimney, which called for the laying of 15,000 perforated radial brick and 5,000 fire brick for the lining. Red radial brick were used for the facing. Progress on the main chimney column averaged 6 ft of height per day. All materials were wheeled into the chimney, hoisted up on the inside by a single-drum gasoline-driven hoist, and placed from a pudlog scaffold supported on the brickwork and raised each day as the work progressed. Upon completion, the outside brickwork was cleaned down to remove mortar stains.

The chimney was designed and constructed to meet Specifications CE-208-JAN 1947 of the Corps of Engineers, which limits tension and compression in the brickwork to 34.7 and 347 psi respectively, considering a lateral wind load of 18 lb per sq ft of projected area and a unit weight of brickwork not less than 110 lb per cu ft. The chimney's maximum design capacity is 700 boiler hp.

For reinforcement, concealed steel bands 3 × $^1/_4$ in. were placed at intervals in the outer brick column and covered by 4 in. of brickwork for protection from corrosion. At the top, the brickwork is protected by a sectional cast-iron cap of $^3/_4$-in. metal with edges turned down $2^1/_2$ in. over the brickwork. At the breeching and cleanout openings steel lintels and special reinforcement are provided.

The perforated radial brick had to meet rigid requirements, including a minimum crushing strength of 5,000 psi, figured on the gross cross-sectional area. Samples from several brick plants were tested before the brick was ordered from a West Virginia source. Brick were bonded together with mortar consisting of 1 part portland cement, 2 parts hydrated lime, and 6 parts clean sharp mortar sand. A mechanical mixer was used.

Firebrick Lining Vented to Atmosphere

For a height of 35 ft above the foundation the chimney is lined with solid intermediate heat-duty circle firebrick $4^1/_2$ in. thick. These brick were laid in a high-temperature air-set cement mortar with joints not exceeding $^1/_{16}$ in. At the bottom and top of the lined section the chimney is vented to the atmosphere by cast-iron vents extending through the outer wall to permit a flow of cooling air between the lining and the shaft and reduce thermal stresses in the chimney column. At the top of the lining, the air space is sealed by mineral wool packing designed to permit expansion of the lining without producing disruptive stresses.

The chimney has an inside diameter at the top of 4 ft 6 in. and at the bottom of 5 ft 11 in. The wall thickness at the top is $7^1/_8$ in. and at the bottom $11^3/_4$ in. The breeching opening is 3 ft 2 in. × 5 ft 6 in. and there is also a 2 × 3-ft access opening at the top of the foundation for inspection and cleaning, closed by a cast-iron frame and door. The outside bottom diameter is 9 ft $3^1/_2$ in.

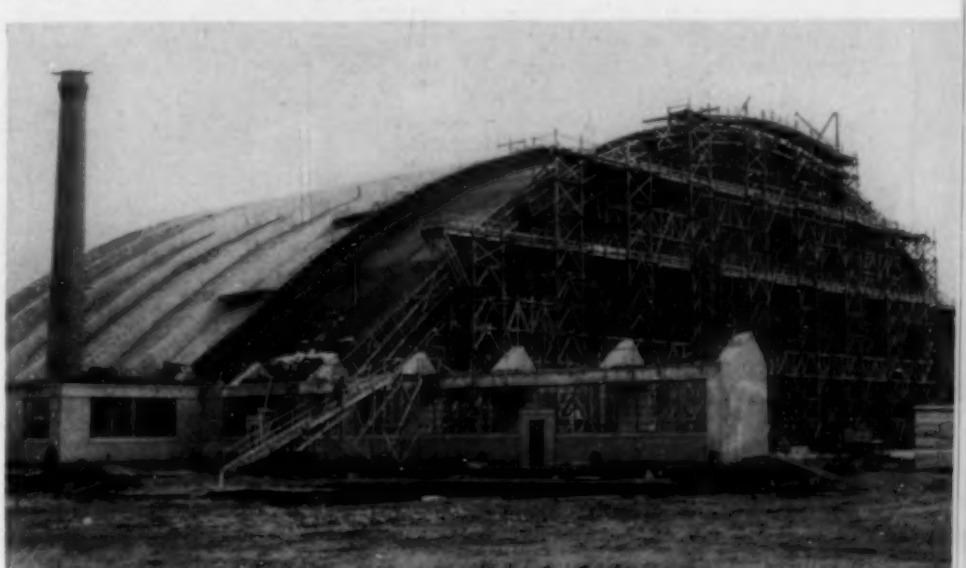
Lightning protection is secured by means of three copper-point rods of $^3/_4$-in. diameter and two stranded copper down conductors $^1/_2$ in. thick. At the top and bottom of the stack the cables are interconnected by a horizontal circuit cable of $^1/_2$-in. diameter. Three $^3/_4$-in.-dia copper rods 10 ft long driven below grade provide grounding for the lightning protection system. The upper 25 ft of the system is sheathed in lead $^1/_{16}$-in. thick. Cables and points are securely anchored to the stack by inserts placed in the brickwork during construction.

Access to the top of the chimney is provided by $^3/_4$-in. wrought-iron ladder rungs embedded in the brickwork and spaced 15 in. on centers, with guard rails encircling the rungs at 5-ft intervals. The rungs are safety type, with a 15-in. tread turned down 2 in. below the horizontal leg.

Inserts for attachment of aviation obstacle lights and wiring were placed in the brickwork during construction. The lights, which are at the top of the stack, can be lowered to the ground on guide cables for servicing.

The structural engineers for the hangar and chimney are Roberts & Schaefer Co. of Chicago. The chimney above the foundation was constructed by the Alphons Custodis Chimney Construction Co. of New York and Chicago, under a subcontract with the Steenberg Construction Co. of St. Paul, Minn., prime contractor.

RADIAL BRICK CHIMNEY for hangar heating plant has foundation combined with one of hangar arch footings for efficiency. In recent view of Rapid City, S. Dak., Air Force hangar, new centering is in place for pouring of fourth monolithic roof section. See preceding article by Col. Louis W. Prentiss.



UNDERPASS AT JAMAICA, L.I., carries more than 1,300 trains every 24 hours. Underpinning and shoring are complicated by this traffic, which reaches peak of more than $1^1/_2$ trains per min in morning.

Double-Deck Underpass Rebuilt Without Delaying Traffic of Thousand Trains per Day

CHARLES B. MOLINEAUX, M. ASCE

Chief Engineer, The Arthur A. Johnson Corp., Long Island City, New York

REBUILDING a double-deck railroad bridge to permit widening of the highway beneath without interfering with train schedules is a job that requires unusual planning and execution. The Long Island Railroad bridge over Van Wyck Boulevard in Jamaica, N.Y., has 9 tracks on its lower level and 4 on a skew with them on the upper level. Train movements are at the rate of more than one per minute in the busy hours and total approximately 1,300 per day.

The job involves widening Van Wyck Boulevard by about 95 ft, and lowering its grade 4 to 10 ft, which necessitates pouring a new concrete abutment, erecting two new cross bents and lowering the footings of a third bent to be rebuilt. The problem includes supporting the two-story railroad-carrying structure while the permanent work is being done.

Substructure to Be Completed First

The procedure is to complete all the substructure before beginning to place the permanent steel and other items the placing of which will affect the train schedules. After the substructure is completed, the tracks will be taken out of service one at a time, and the permanent superstructure completed. In taking the tracks out of service, it will of course be necessary to reroute the trains. To facilitate this rerouting, the contractor was required to move two signal bridges, which will be replaced upon completion of the job. Communication lines that were carried over the railroad bridge are strung on poles and carried around the construction area. A power duct, which ran through the bridge, was brought down to the ground and carried below the construction area in a temporary duct line.

The bents and abutments are referred to herein by the numbers shown in Fig. 1. Bent 14 is the one to be rebuilt; 15 and 16 are to be newly erected. It was necessary to redesign No. 14 because span 14–15 was increased.

In replacing Bent 14, brackets were riveted to the old columns. The loads were then transferred through the brackets to steel needle beams supported by cribs on the old roadbed. The old footings were then removed and the new footings poured. After the concrete had set four or five days, the old columns were set on short temporary piers resting on the new footings. Each time that the load was transferred, four 100-ton hydraulic jacks were used to assure

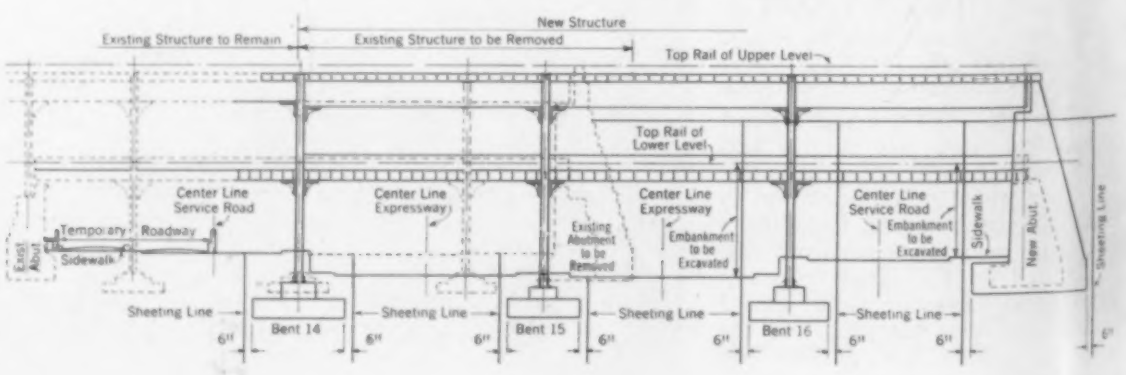


FIG. 1. ELEVATION OF GRADE SEPATION under Long Island Railroad shows both old and new abutments of railroad trestle; also new grade and location of Van Wyck Boulevard.

COLUMNS FOR BENT 14 are underpinned (left). Brackets have been bolted in place and riveted; loads have been transferred to underpinning by hydraulic jacks. Column loads run as high as 593 tons.

OLD FOOTINGS have been removed (right) after columns were underpinned and trench excavated to grade for pouring new footings. Special method of sheeting trench is made necessary by heavy surcharge from needle beams.

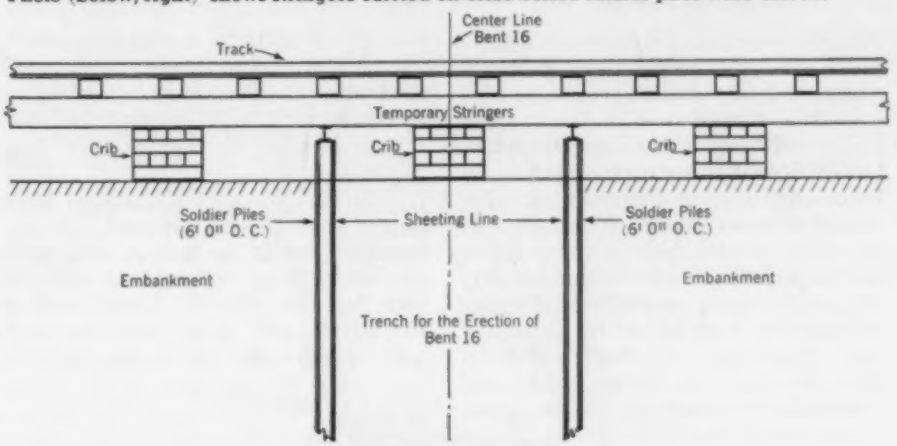
full bearing and to take up the initial settlement of the soil which would have caused cracks or minor distortion in the structure. In placing a load of such magnitude so close to the excavation for the new footing it was essential to sheet the pits with great care in order to avoid loss of ground. Ring sheeting was used for this purpose.

Bent No. 15 falls close to the old abutment, its footing being partially under it. The footing was built sectionally, alternate 6- to 10-ft sections being excavated, sheeted and poured without shoring the abutment, thus permitting its continued use. In each section the reinforcing steel which projected beyond that section was bent up between the forms and the sheeting before concreting. When the adjacent section was excavated, the steel was bent down to the designed position in that section before concrete was poured.

Bent No. 16 and the new abutment fall outside the old limits of the under-pass, and in the embankment. The method followed for excavation is shown in Fig. 2. The tracks were taken out one at a time and relaid on top of temporary stringers supported on cribs. The stringers were supported by cribs which were mined in under the stringers in two steps. Pits were excavated to approximately half depth and midway between permanent cribs; the load of the stringers was then transferred to these "half cribs" and excavation for full-height cribs was done in the same manner. The cribs that were within the excavation lines of the bent and abutment trenches were supplanted by the soldiers acting as piles in addition to their usual function of supporting the bank for excavation.

(*Continued on page 98*)

FIG. 2. ELEVATION OF TRACK STRUCTURE shows temporary stringers resting on cribs. Soldier piles are driven on either side of center line of Bent 16, capped and shimmed to take load from crib on center line so that crib can be removed and trench excavated for Bent 16. Photo (below, right) shows stringers carried on cribs before soldier piles were driven.



FOOTINGS FOR BENT 15 (below) extend under old abutment. As shown, 6- to 10-ft sections were excavated and footing poured. This procedure eliminated shoring of abutment and kept it in use.

Why Bridges Fail in Floods

Model Tests of Erosion Around Bridge Piers Indicate Depth of Scour in Erodible Material

C. J. POSEY, M. ASCE

Professor, University of Iowa, Iowa City; Director, Rocky Mountain Hydraulic Laboratory, Allenspark, Colo.

OF UNUSUAL INTEREST to highway and bridge engineers is Professor Posey's description of the modus operandi of the forces that undermine bridge piers. The method employed blazes a new approach to an age-old problem. Turbidity, acting as an impenetrable screen, has baffled most investigators in the past. The result achieved by Professor Posey and his collaborators stands as a purely voluntary contribution to engineering science. It was made possible by a group of engineers, for the most part members of ASCE, who spend their summer vacations at the Rocky Mountain Hydraulic Laboratory. (See item in CIVIL ENGINEERING for April 1947, page 64.) The tract of land belonging to this non-profit organization has developed into a veritable playground for engineers and scientists, where wits can be matched, amid gorgeous surroundings, on a variety of problems demanding solution. The laboratory was host last summer to 14 members of ASCE, to engineers from several foreign countries, and to a number of university students who find relaxation and pleasure while gaining practical experience in experimental work. The experiment described by Professor Posey was made at the suggestion of the Joint Committee on Floods, ASCE, through its Subcommittee on Underscour at Bridge Piers and Abutments.—Gerard H. Matthes, Chairman, Joint Committee on Floods, ASCE.

WASHING OUT or undermining of piers and abutments is a common cause of bridge failures. To be able to reduce the chances of this type of failure without unnecessary expense, the bridge engineer must improve his knowledge of open-channel hydraulics and of stream erosion. Although considerable information in these fields, and especially the former, is already available, much experimental work needs to be done before the substructure of a bridge on erodible foundation material can be as safely and economically designed as its superstructure.

New Test Method Developed

Tests of scour around bridge piers by Rehbock and by Tison have focused attention on the difficulties of such experimental work. The method of testing described here was suggested by Gerard H. Matthes, Hon. M. ASCE, and first used during the summer of 1948 in a trial series of runs in the 6-ft flume of the Rocky Mountain Hydraulic Laboratory at Allenspark, Colo. Mr. Matthes' suggestion was that the pier should be hollow and transparent so that depth-of-scour readings could be taken inside the pier while the apparatus was being run at equilibrium conditions, thus avoiding the changes which ordinarily occur when the discharge is shut off and the model unwatered to permit direct measurements of scour depth. The crystal-clear water available at the Allenspark Laboratory made it an ideal place to try this method.

Actually, the method proved even better than was anticipated. Measurements could be taken, not only of the depth of scour all around the pier, but also of the general level of the stream bed away from the pier, and observations of vortexes, kolk action, and movement of sand particles could be made with ease, whereas most of these phenomena were found to be completely obscured when attempts were made to see them by looking down through the free water surface. Kolk, a word borrowed from European literature, denotes stream-bed deepening by vortex action. The term has been in extensive use by engineers in Holland and Germany for more than a quarter of a century. It has been used in this country since 1947.

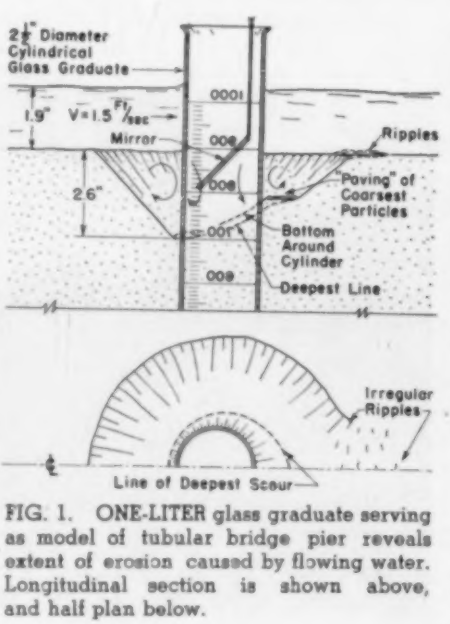


FIG. 1. ONE-LITER glass graduate serving as model of tubular bridge pier reveals extent of erosion caused by flowing water. Longitudinal section is shown above, and half plan below.

TABLE I. SIEVE ANALYSIS OF SAND USED IN TESTS

Sieve No.	% Coarser
8	5
14	12
28	32
48	70
65	78
100	88

As shown in Fig. 1, the "pier" was a 1-liter glass graduate, and the observations were made with the aid of a small mirror mounted at 45 deg on the end of a wire handle. The depth of scour next to the pier could be read directly on the scale of graduations, conveniently rectified by the mirror. The general level of the stream bed away from the pier could also be read by noting the position on the scale of a line of sight passing right along the level of the bed. The depths shown in the figure are for equilibrium conditions with a water discharge of 1.39 cfs and a sand discharge of 20 lb per min.

The sand was a graded fine sand with 5 percent retained on a No. 8 sieve and 70 percent retained on a No. 48 sieve. The sieve analysis is shown in Table I. The equilibrium shape of the scour hole, shown in the figure, was attained very quickly. If the scour hole was filled up suddenly with a shovelfull of sand, it would erode back to its original size in two or three minutes. Bottom measurements taken after shutting off the water were a little higher. This result was apparently due to the settling down of the sand in suspension in the vortex.

Direction of Sand Movement Studied

It was surprising to note that the movement of sand picked up by the vortex was downward next to the

(*Continued on page 90*)

Improved Education in Special Fields of Engineering Urged at ASCE Annual Meeting Technical Sessions

Atom Bomb Necessitates Industrial Dispersion, Security Expert Tells City Planners

ATOMIC BOMBING possibilities, family housing requirements, and master plans and municipal regulations as engineering tools were phases of city planning discussed at two sessions of the City Planning Division. Frank H. Malley, Providence, R.I., chairman of the Division's Executive Committee, presided at the first session, and Leslie Williams, New York, Secretary of the Executive Committee, presided at the second.

Frank H. Malley, Chairman, City Planning Div.; Director, City Plan Commission, Providence, R.I.

The initial session was taken up by a paper, "National Security Factors in Industrial Location," by Dario G. Barozzi, Assistant Director of Industrial Dispersion, National Security Resources Board, Washington, D.C., and discussions. Four papers were presented in a panel discussion, "Neighborhood Approach to Planning," at the second session with Lawrence V. Sheridan, Indianapolis, member of the Division's Executive Committee, summing up the discussions.

Papers presented in the panel were: "State Systems," by Hugo H. Winter, State and Parkway Engineer of the Los Angeles Bureau of Engineering; "Schools and Recreation," by John M. Picton, Chief Planning Engineer of the Kansas City Plan Commission; "Housing and Development Projects," by Louis Wetmore, Providence Redevelopment Commission; and "Shopping and Business Centers," by Myron Hendee, Land Planning Consultant, Federal Housing Administration, Hackensack, N.J.

Hugo H. Winter

Los Angeles' master plan of streets and highways and its local subdivision regulations were hailed as "the most important tools available to the city engineers and planners to insure proper planning of a neighborhood street system," in Mr. Winter's paper.

"Under the master plan, it is possible to require the dedication of traffic streets to proper widths at proper predetermined locations and spacing," he said. "Under the subdivision ordinance and regulations, control may be exercised over the location and design of local or access streets within the neighborhood by the control of lot sizes and the widths of street rights-of-way and roadway widths."

Admitting that most of the areas within cities have already been subdivided so that, "except for the opportunities of redeveloping some of these areas that have fallen into substandard conditions, it is not possible to mold these areas into self-contained neighborhood units," Mr. Winter emphasized:

"Where subdivision has not taken place or where redevelopment is contemplated, a real opportunity exists for the creation of self-contained neighborhood units, by the advance planning of these areas. In Los Angeles, for example, there are many square miles in the San Fernando Valley and fewer square miles in the Westchester and other areas of the city that have not as yet been subdivided. But the entire city has been zoned, thus establishing the allowable and desirable uses of these areas. A master plan of streets and highways has been adopted, city and county wide. And so the City Planning Department staff, as a guide for future development, is working out subdivision plans for all vacant areas of the San Fernando Valley, taking advantage of all modern neighborhood planning techniques. These plans for subdivision are discussed with owners of the properties as it is known that they intend to subdivide, with the result that more acceptable and efficient use of land is secured. It has proven to be true that the best use of land based on the better planning principles does not generally reduce the number of usable lots which can be developed in an area as compared to a poor plan with no neighborhood unity."

Louis Wetmore

Families whose space requirements change over the years as their numbers grow and diminish won't have to move from one vicinity to another and break ties of friendship under a plan of "neighborhoods with a variety of types of houses at varied rental levels" envisioned in Mr. Wetmore's paper.

Detailing work under way in Rhode Island's capital in planning a new residential community of 1,200 homes to house 5,000 persons, with residences ranging from apartments to group housing and single-family dwellings, Mr. Wetmore said:

"The requirments of an American family change rapidly. A family of two starts with minimum space requirements. For 10 or 15 years the home expands; it then contracts for a like period until it again has to meet the original requirements for a family of two. Segregation of apartments in one section of the city makes it necessary for a family as it grows or contracts to move about and break its ties with a neighborhood and friends of years' standing. This could be obviated by providing a number of different types of housing within the neighborhood so that the family could meet its changing housing needs without uprooting its social life.

"The variety of housing types should be accompanied by a variation in rental values; otherwise, the young, growing family, hard-pressed financially, might not find housing

which it can afford in the same area with parents and older friends. A segregation by income levels is as unsatisfactory as a segregation by housing types. This does not mean, of course, a mixing of one-family houses, valued at $25,000, with apartment structures renting for $50 a month. It does mean that within an area nearly a mile long, and with a population of 5,000 there is room for apartment developments in one section, group housing in another, and single-family housing in still a third. Moreover, some land by its geographic location or because of subsurface conditions is better suited to apartments or group housing than to a single-family development."

Dario G. Barozzi

If your town has less than 50,000 population and 10 miles of open country between it and an industrial concentration of five square miles, you may find atomic-age comfort in knowing that it "probably will not be strategically feasible" for an enemy to attack you—either with the atom bomb or the more conventional airborne missiles.

Of course, if your town or the industrial concentration "contains specific installations of decisive importance to the nation's capacity for defense," that's apt to be a different matter, it was brought out in the paper presented by Mr. Barozzi, who said: "Dispersion which will minimize the number of concentrations of more than five square miles or more than 50,000 people is thought to be our best security."

Mr. Barozzi emphasized that reasonable security can be achieved within existing regional frameworks, and industry-wise dispersion "must be such that it can be woven into our private-enterprise system with minimum difficulty and be economically feasible." Population-wise, he said, dispersion "must be thoroughly consistent with efforts toward better standards of living and working." While suggesting that federal policy "might take the form of providing technical and possibly financial assistance" to state, regional and local planning commissions, Mr. Barozzi stressed the point that the Security Board's planning for dispersion "involves no mass exodus from our larger metropolitan areas" and that it "can hardly be construed as an effort to stampede American industry and the American people into a hysterical repudiation of our free and easy way of life."

Calling dispersion "life and property insurance in the atomic age," Mr. Barozzi said: "Were the premium for security to mean the abandonment of our urban and industrial civilization for caves and subterranean dwellings, the protection would not be worth the price."

Highway Engineering Career Called Way to Aid Nation's Welfare, Economy

ONLY THE PIONEER phase of road building has been completed, and the improvement of "a very large mileage of roads built in earlier years," to alleviate traffic congestion and safety hazards, is one of the major problems to be overcome in a program "of vital importance to the national economy and the welfare of the country."

This was brought out by C. D. Curtiss, Deputy Commissioner, Public Roads Administration, Washington, D.C., in one of five papers presented at the Highway Division session, over which Gibb Gilchrist, College Station, Tex., chairman of the Division's Executive Committee, presided. Mr. Curtiss spoke on the general subject, "Outlook for Highway Engineering Graduates," and his paper was presented from the standpoint of government service. Others speaking on the same general subject were Hal H. Hale, Executive Secretary, American Association of State Highway Officials, Washington, D.C., whose subtitle was "As a Professional Man"; and D. C. Greer, Texas State Highway Engineer, "In the State Service." In addition, Prof. Ben H. Petty of Purdue University's Highway Engineering Department presented a paper, "Needs of Highway Engineering Education." All papers were presented under the general symposium subject, "Highway Engineering as a Career."

Gibb Gilchrist, Chairman, Highway Div.; President, Texas A. & M. College

Ben H. Petty

Deploring the lack of trained highway engineers having a "coordinated and comprehensive viewpoint," Professor Petty advocated special courses in highway engineering. Answering his own question, "Why Teach Highway Engineering?" Professor Petty asserted:

"The highway engineering industry is already seriously handicapped by having far too many engineers on the payroll who are locating engineers *only*, structural engineers *only*, testing and research engineers *only*, and construction or maintenance or traffic engineers *only*. Highway engineers who have a reasonable knowledge of and interest in the entire field of highways are few and far between. It is a mystery to me why so many engineering schools ignore the subject of highway engineering completely. Yet they will devote the equivalent time to other subjects which play a relatively minor part in our economy and offer only a small fraction of the opportunities for employment that are wide open in the field of highway engineering."

Professor Petty decried "the fact that far too many among the general public and the teaching profession, not directly connected with the highway industry, are confident in their own minds that they are curbstone experts on the subject of highway engineering." He pointed out that in his own institution, "if we add up the actual hours in lecture, recitation and drafting, plus examination periods, it totals just 96 hours or, on the basis of an eight-hour day, the equivalent of 12 days."

C. D. Curtiss

Reviewing briefly the history of the Public Roads Administration and the development of modern highways in the United States, Mr. Curtiss stressed the advantages of a highway engineering career with the Public Roads Administration. He told of opportunities for advancement and emphasized the value of the PRA training program.

"In the Public Roads Administration considerable importance is attached to the training of professional personnel in all grades," he said.

"Training is provided either in more or less formal courses or by individual on-the-job instruction. In the Junior Engineer training program a course has been developed which is designed to furnish a thorough grounding in the fundamentals of highway engineering and the work of the Public Roads Administration. A full year is spent on surveys, design and construction; six months in the Physical Research Laboratory assisting in special research projects as well as in routine testing of road-building materials, including soils and interpretation of test results; six months on field studies of construction operations and equipment performance; six months working with more experienced engineers in the various phases of federal-aid administration; and finally, six months in the Washington office working in the several departments.

"One point should be obvious. The conception of the highway engineer as a person who spends his time looking through a level or transit is most misleading. While we must still establish grade and line, highway engineering today involves very responsible work in a variety of research activities, in the constant improvement of the design of both roads and bridges, in special fields such as hydraulics and soil mechanics, in the development of more efficient and effective methods of construction, maintenance and equipment utilization, and in the various phases of administration.

"There is a very real challenge in the present phase of road building for highway engineers, not only in the Public Roads Administration, but in the state highway departments and in the contractors' and equipment manufacturers' organizations as well. Much research, planning and careful administration is necessary to utilize most effectively the funds available in improving our highways to meet present-day needs and in addition to provide for future traffic. Continued improvement in construction methods and in the development and utilization of equipment is also necessary."

Engineers Cite Economies Effected at Home, Abroad in Hydroelectric Expansions

IN TWO SESSIONS of the Power Division, over which Arthur T. Larned, New York, Chairman of the Division's Executive Committee, presided, the following papers were presented: "World-Wide Dam Construction," by A. V. Karpov, Pittsburgh consulting engineer; "Power Development in the Philippine Islands," by F. C. Rodriguez, Manager, National Power Corp., Manilla, P.I.; "Report on Meeting of International Congress on Large Dams in Stockholm, Sweden," by Joel D. Justin, Philadelphia consulting engineer; Illustrated Description of European Trip to Congress on Large Dams," by Francis S. Friel, Philadelphia consulting engineer; "New Trends in Hydroelectric Power Plant Design," by W. S. Merrill and M. G. Salzman, Hydroelectric Engineers, Ebasco Services, Inc., New York; and "Welded Penstock Designs and Construction for Hydro Plants," by P. J. Bier, Bureau of Reclamation, Denver.

A. T. Larned, Chairman, Power Div.; Chief Civil Engineer, Ebasco Services, Inc., New York, N.Y.

Joel D. Justin

Describing ledge rock at the powerplant sites visited in Sweden, Mr. Justin said the rock is generally gray granite and in excellent condition, with few seams and no detectable joints.

"Except for a few locations in northern New York and New England and the State of Washington, I have seen nothing like it in America," Mr. Justin said. "I talked with Swedish engineers about various forms of bracing in tunnels, both wood and steel. With them it was entirely a theoretical question because they practically never need any support of this material. This excellent quality of rock makes it economical to use underground construction which we, in America, seldom use successfully.

"The reason for putting the plants underground is primarily economic and not for protection during wartime. Thus, take the case of a 380-ft-head plant. The water at the intake plunges down through conduits to tailrace level, where the powerhouse and machinery are located in an enlarged space cut out of the ledge rock. The cost of the powerhouse thus formed is only about that of rock excavation in solid granite ($6 per cu yd in some cases), whereas the cost of a powerhouse constructed in America may be $1 per cu ft or $27 per cu yd. In other words, the cost of a powerhouse hollowed out in the rock may be one-quarter that of a powerhouse built above ground in the usual American manner."

W. S. Merrill and M. G. Salzman

Discussing the large-scale expansion program of the electric power industry in the United States, Canada and foreign countries, Messrs. Merrill and Salzman asserted:

Notable achievements and progress have been made in recent years in the design and construction of dams, waterways and powerplant structures. Hydroelectric turbine manufacturers have contributed to this advancement by developing new techniques in fabrication as well as improvements in the performance of their equipment. The trend has been toward simplification, both with respect to construction and operation, with a view toward reducing over-all investment and operating costs. Small low-cost plants are being built, with much of the equipment outdoors to lower building costs. There are possibilities of further economy to be gained by the elimination of much of the non-revenue-producing features to parallel the advances made by the full outdoor-type steam plants, where only operators and indoor-type electric equipment are housed.

"Standardization of equipment and the unit plan of development are also becoming more prevalent. Many of the new plants being designed and installed by utility companies are planned for remote operation or supervisory control to reduce operating costs. Some older plants are being modernized and converted to automatic or semi-automatic operation.

P. J. Bier

The subject of penstocks for conveying water under pressure from forebay or reservoir to hydraulic turbine for the production of power has not been given very much attention in engineering literature, Mr. Bier pointed out in his paper. He asserted that the thousands of penstocks and other pressure conduits in service today, and representing a tremendous invest-

ment, warrant a better understanding of the subject.

"Based on some 20 years of experience in penstock construction," he said, "the Bureau of Reclamation has developed certain design standards and construction practices."

Mr. Bier then told of the work done by the Bureau in this field and summarized as follows:

"As improvements are being made in materials, welding technique, inspections and tests, the construction of penstocks will advance, requiring changes in the present design and production practices. The metallurgy of welding is a complicated subject, calling for much additional research to explain some of the problems connected with welding which are not fully understood today. Continued teamwork between metallurgist, welding specialist and design engineer will no doubt bring further advances in welding which should lead to better quality and more economical welded conduits."

Committee on Earth Dams Sponsors Symposium at Two Soil Mechanics Meetings

A SYMPOSIUM sponsored by its Committee on Earth Dams was heard at two sessions of the Soil Mechanics and Foundations Division, with Frank A. Marston, Boston, chairman of the Division's Executive Committee, presiding.

Frank A. Marston, Chairman, Soil Mechanics and Foundations Div.; Construction Engineer, Metcalf & Eddy, Boston

Introductory remarks by William P. Creager, chairman of the Committee, were followed by papers on "Transient Flow," by Prof. Philip Rutledge, Northwestern University, chairman of the Division's Committee on Seepage and Drainage; "Compaction of Cohesive Soils" by R. R. Philippe, Ohio River Division, U.S. Engineers, chairman of the Division's Subcommittee on Consolidation of Materials in Earth Dams and Their Foundations; and "Slope Protection and Effect of Waves on Riprap," by Martin A. Mason, War Department Beach Erosion Board, Washington, D.C., a member of the Division's Subcommittee on Slope Protection.

At the second session, papers presented were "Circular Arc Method of Design of Earth Dams," by Prof. Donald W. Taylor, Massachusetts Institute of Technology, chairman of the Division's Subcommittee on Design of Earth Dams and Their Foundations; and "The Time Lag in Observation of Groundwater Levels and Pressures," by M. Juul Hvorslev, Consultant, Waterways Experiment Station, Vicksburg, Miss.

Martin A. Mason

Wave action, described by Mr. Mason as "the primary factor to be considered in the design of slope protection for earth dams," was called by him "the factor which is most poorly known to, or understood by, the engineering profession." The extensive study of wave action in reservoirs now being conducted by the Corps of Engineers holds promise, Mr. Mason stated, of adding to our knowledge a large quantity of factual data "which can lead to a satisfactory solution, at least in part, of the more pressing problems of wave action on dam slopes."

Six Papers on Divergent Subjects Feature Two Structural Sessions

SIX PAPERS on divergent subjects were presented at two sessions of the Structural Division, over which John I. Parcel, St. Louis, Mo., chairman of the Division's Executive Committee, presided. Friedrich Bleich, Consulting Engineer, Frankland and Lienhard, New York, and L. W. Teller, Principal Engineer of Tests, Public Roads Administration, Washington, D.C., co-authored a paper on "Structural Damping in Suspension Bridges." Professor D. C. Drucker, Graduate School of Applied Mathematics, Brown University, presented a paper, "The Plasticity of Metals—a Discussion of Mathematical Theory and Its Application to Engineering Problems." The third paper at the first session of the Division was "Buckling Stresses for Flat Plates and Sections Made of Assembled Flat Plates," by Elbridge Z. Stowell, George J. Heimerl, Charles Libove and Eugene E. Lundquist, National Advisory Committee for Aeronautics, Langley Field, Va.

At the second session, the following papers were presented: "Approximation in Rigid-Frame Analysis," by Prof. L. T. Wyly, Purdue University; "Lateral Buckling of Eccentrically Loaded Columns," by H. N. Hill and J. W. Clark, Research Laboratories, Aluminum Co. of America, New Kensington, Pa.; and "A Study of the Effects of Heating and Driving Conditions on Hot-Driving Structural Steel Rivets," by Prof. R. A. Hechtman, University of Illinois.

John I. Parcel, Chairman, Structural Div.; Svərdrup & Parcel, St. Louis, Mo.

Friedrich Bleich and L. W. Teller

A theoretical approach for solving the problem of damping in a bridge structure is possible, provided that basic experimental data are available as to the logarithmic decrement of internal damping in rolled,

riveted and welded structures and the amount of friction which can be safely assumed as acting between the sliding parts of the structure," Messrs. Bleich and Teller declared in their paper.

Their presentation was a condensation of a report submitted to the Advisory Board on the Investigation of Suspension Bridges, which was organized in 1942 under the sponsorship of the Public Roads Administration to assume general direction and supervision of the investigational work covering dynamic oscillations of suspension bridges in response to the widespread demand for such a study which followed the collapse of the Tacoma Narrows Bridge from wind action in 1940.

In introducing their theoretical approach to the problem, the coauthors asserted:

"Experimental investigations regarding the behavior of suspension bridges under the action of wind, which had been carried out for several years, disclosed that the capacity of a vibrating bridge structure to dissipate the energy fed into it by pulsating wind forces, in general, has an important bearing on the condition of dynamic stability of the structure. It is questionable whether information on structural damping in suspension bridges could be obtained by field tests on existing long-span bridges because of the prohibitive costs, even if suitable methods could be devised for artificially vibrating the formidable mass of such a bridge. Moreover, such field tests can only yield data on the over-all damping capacity of the structure, a capacity which may vary to a large extent from bridge to bridge, but cannot provide the basic information on the actual sources of the energy-dissipating capacity of the structure or on the real nature of the damping phenomena in suspension bridges. Such detailed information, however, is necessary in studying ways and means to insure the required damping capacity in any given bridge design.

"It must be realized, also, that laboratory tests as conducted on field models cannot furnish real information on the damping quality of the prototype for it is impossible as a practical matter to duplicate the structure of a bridge to reduced scale in such detail as to reliably represent the condition of friction existing in the prototype."

D. C. Drucker

In his paper, Professor Drucker analyzed briefly the philosophy and practice of engineering design, emphasized the importance of plasticity in most elastic design and illustrated the use of elementary plastic analysis. Discussing applications to beam and truss frameworks and structural stability, Professor Drucker showed by simple examples the difference between plasticity and non-linear elasticity and described the development of mathematical theories of plasticity and the experimental results upon which they are based.

Professor Drucker stated in his conclusion:

"If practical answers are to be found to many engineering problems of importance and the factor of safety is to be put on a firm calculable basis, a large number of complicated plasticity problems will have to be solved. The great expenditure of effort that will be required makes it desirable to use as simple a theory of plasticity as is permissible for each problem. Much more experimental information is necessary than exists at present.

"Work has already been started and should continue on an expanded scale along the fruitful path of investigating tubes under internal pressure, tension, and torsion where the ratios are purposely varied during the test to check particular questions."

Surveyors Note Need for Making Profession Attractive to Young Engineers

A PANEL DISCUSSION of "Property Surveying, Its Customs and Problems," with a representative from the North, South, East and West participating, comprised the session of the Surveying and Mapping Division, over which Prof. G. Brooks Earnest, member of the Division's Executive Committee, Cleveland, presided. Participating were: Ford Bartlett, Brooklyn, N.Y.; W. C. Wattles, Glendale, Calif.; John P. Goggin, Clare, Mich.; and Clifford A. Betts, Chattanooga, Tenn.

I. S. Dodds, Chairman, Surveying Div.; Professor of Civil Engineering, Iowa State College, Ames, Iowa

Early-day political and professional evils and inaccuracies were blamed for some of today's difficulties encountered by the professional surveyor, and emphasis was placed on the fact that this branch of civil engineering fails to attract its proper share of younger engineers.

Ford Bartlett

Many speculative builders, with little or no experience in the techniques of building construction, consider a property survey "merely another commodity, something to be bought cheaply and delivered to the bank in order to get mortgage money," Mr. Bartlett declared. "Having no understanding or appreciation of proper standards, they consider it economical to ask for bids and give the work to the lowest bidder. This unfortunate practice is not always confined to the uninformed. Some of the agencies in our city and state, as well as the Federal Government, follow the same procedure. The above factors have had a detrimental effect on the practice of surveying and also have discouraged young engineers who may have had an interest in making a career in this field.

"This need not continue to be true. Certainly, the influence of all interested engineering societies should be brought to bear in eliminating this practice."

W. C. Wattles

In western surveying work, with the large areas to be covered, the great variety of record data, the experience and knowledge required of methods and practices of predecessor surveyors, and the necessity, in most cases, for an acceptable conformity with check controls, the present-day surveyor has no easy time of it, Mr. Wattles said.

He emphasized, however, that it is futile to "bewail the lot of the land surveyor," or criticize destructively.

"Rather let us present the facts," he said, "recognize the ills, and endeavor to remedy the situation for the betterment of the profession in all areas. The surveyor who takes his profession seriously and conscientiously has a fine and fertile field for endeavor, with many excellent assistants in the records, the field, and in the helpful advice from those whose business it is to exercise control of land and title surveys."

Asserting that the Los Angeles system is "not perfect or complete by any means," Mr. Wattles concluded: "But continued experiment, changes of procedure suggested by interested and informed professional men, and a general willingness to improve and develop on the part of a majority of the surveyors and engineers, are definitely raising the standard of accuracy and efficiency in property surveys."

John P. Goggin

"After the timber was slashed out of Michigan and the watershed lowered, land became so cheap in the northern areas that it would have cost more to survey it properly than you could have bought it for," Mr. Goggin stated in his paper. "This resulted in many incompetent part-time surveyors performing the work that subsequently became our headaches today. In fact, to be a competent surveyor in the state of Michigan today, one must be at once a civil engineer, a land surveyor and a lawyer. The academic background, if any, of many of the old surveyors was such that they could not even write a proper description and they transferred this function to the practicing attorneys and abstractors, with the end result that it is not at all unusual to find recorded descriptions that when plotted result in straight lines, Z's, tracts open on one end, and very often gaps and overlaps. It would be almost impossible to be a competent property surveyor in Michigan without an understanding of the philosophy of the law of boundaries."

Mr. Goggin said that the Michigan Plat Act and the Michigan Registration Law have done much to protect the public and the surveying profession from the practice of incompetent operators, "but until the code of ethics of the profession prevents an engineer from attempting to do work for which he is not qualified, and until standards such as those promulgated by the American Congress of Surveying and Mapping are more or less quasi-legally required, poor work will continue to result in loss of respect for that branch of civil engineering commonly known as land surveying.

"Unfortunately, ignorance on the part of clients, the indifference of our fellow engineers in other fields and the disinterest of the legal profession, coupled with the unfair competition of licensed incompetents, make our path a difficult one, and it is only through opportunities such as this meeting that our problems can be aired in the hope that the American Society of Civil Engineers will continue to aid us through the Surveying and Mapping Division as it has so ably done in the past."

Clifford A. Betts

In his paper, Mr. Betts told of his 38 years of survey and general engineering practice in the vicinity of Chattanooga and the legislative progress made in the field of surveying.

"Original lines in most cases were marked on the trees and the corners of sections and tracts were referred to trees described as pointers," he said. "In some urban and uninhabited mountainous areas, corner and line trees with original marks may still be found, but this is the exception rather than the rule.

"Prior to 1939, our localities were lacking in control points. At that time the Tennessee Valley Authority began to publish information as to the positions, elevations and descriptions of bench marks and horizontal control stations which were being established in the Tennessee Valley. The expansion of this network of coordinated positions by the U.S. Geological Survey and the TVA made it possible in 1947 to enact a bill establishing a plane coordinate system for Tennessee.

"This act establishes a legal status for the use and recording of plane coordinates in land descriptions. It is not intended that descriptions of land by coordinates should replace the older and accepted methods of description of land by metes and bounds, but their use is proposed merely as a permissive supplement. While the act is a step forward, we feel there should be some modifications requiring less exacting work and permitting the use of traverses of third-order accuracy, rather than second-order as specified. Regardless of the suggested modification, we believe it will be many years before the general use of coordinated surveys will be practical for our section."

Cheaper Harbor Control Methods Called Challenge to America's Engineering Profession

W. H. Smith, Chairman, Waterways Div.; Rear Admiral, CEC, U.S.N., (Retired), Mobile, Ala.

THREE PAPERS were presented at the session conducted by the Waterways Division, with Admiral W. H. Smith, Mobile, Ala., chairman of the Division's Executive Committee, presiding. "New York City's Pier Rehabilitation Program" was the title of a paper presented by Capt. E. A. Verpillot, Deputy Chief Engineer, Department of Marine and Aviation, City of New York. Joseph M. Caldwell, Washington, D.C., presented a paper, "Sedimentation in Harbors." The third paper, "Design of the Harbor and Terminal Facilities at Amuay Bay, Venezuela," was presented by Theodore T. Knappen, Knappen Tippetts Abbett Engineering Co., New York.

Joseph M. Caldwell

Harbor and channel maintenance, which cost American taxpayers one-third as much in the last seven years as was spent on this work in the preceding century, offers a challenge to the country's civil engineers to "save substantial sums by effecting improvements in techniques," Mr. Caldwell pointed out. Asserting that from the inception of the work in the early 1800's to the present, maintenance has cost about one billion dollars, he placed the cost of maintenance at 48 million dollars per year for each of the last seven years.

"The commercial activity of the harbors of a maritime nation is generally a fairly reliable index of the economic health of the nation," Mr. Caldwell said. "Any natural phenomena which serve to restrict the

(*Continued on page 98*)

Engineers' Notebook

Graphical Calculus Solves Three-Span Beam Problem

BRENT C. JACOB
Consulting Electrical and Mechanical Engineer, Bay City, Mich.

GRAPHICAL CALCULUS provides a means of solving many engineering problems. Sometimes it gives an easy method of securing the required answer, as illustrated by the three-span beam problem with the center span loaded symmetrically and the two end spans of the same length without loading.

The beam is of uniform section and supported at four places. The center span can be of a different length from the end spans. With the bending moment diagram of the simple span (BM_1) given, it is necessary only to integrate this BM_1 diagram, draw the line AB as indicated in Fig. 1, and draw a horizontal line through point C, which gives the bending moment in the center span due to end reactions P times l_2. Dividing this bending moment by l_2 gives P, which is added to one-half the load on the center span for reaction R.

Check on Construction

The above construction is known to be correct in this case by the fact that the whole area of the M/EI curve in a span is equal to the increase in slope, (dy/dx) from one end of the span to the other, and tangents to the beam at its ends meet in a point which is in the same vertical as the center of gravity of the whole M/EI curve.

The result is the formula,

$$\tan\beta = \frac{Pl_2^2}{3EI} = \left(\int_0^{l_1/2} BM_1\,dx - \frac{Pl_2l_1}{2}\right)\frac{1}{EI}$$

Therefore

$$\int_0^{l_1/2} BM_1\,dx = \frac{Pl_2^2}{3} + \frac{Pl_2l_1}{2}$$

which is shown graphically by Fig. 1. The point C is given by the intersection of the line AB and the vertical line at a distance $R_1 = 1$ in. from the center line of the mid-span, if the BM_1 diagram is integrated with $R_1 = 1$ in. R_1 is the radius on the Jacob integraph or a corresponding length by another method of integration. After drawing the true bending moment diagram, BM_2, due to the continuous beam, this BM_2 diagram can be integrated once to give the slope curve and twice to give the deflection curve. Integrating the BM_2 curve twice is the same as integrating the slope curve once. Points D and E should be on a horizontal line as the supports are on the same level. The length a should equal twice b as the slope at R equals twice that at P.

The equations:

$$EI\frac{d^2y}{dx^2} = BM; \quad EI\frac{dy}{dx} = \text{Slope}; \quad EI_y = \text{Deflection}$$

work out nicely for graphical calculus solutions as

$$\int BM\,dx = \text{Slope} + C_1$$

and $\int$ Slope dx = Deflection + C_2. The constants of integration, C_1 and C_2, usually are given by physical conditions, as supports on the same level, etc. With variables E and I, the bending moment diagram should be divided by EI before integrating.

If brief equations can be found for the required values, it is faster to use a slide rule.

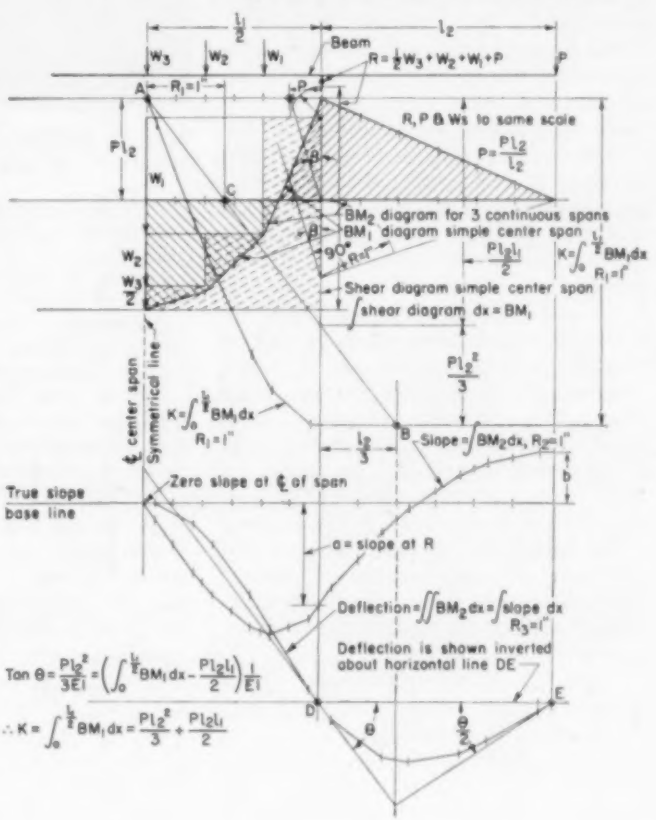

Beam
R, P & Ws to same scale
BM2 diagram for 3 continuous spans
BM1 diagram simple center span
Shear diagram simple center span
Symmetrical line
Zero slope at ℄ of span
True slope base line
a = slope at R
Deflection is shown inverted about horizontal line DE

FIG. 1. GRAPHICAL CALCULUS gives bending moments and deflections in continuous three-span beam, with center span loaded symmetrically and two unloaded end spans of same length.

The numerous examples given in handbooks are also helpful. But such lists cannot give all cases, and it is necessary to work some cases out as shown by the above example.

Graphical Calculus Solves Many Problems

The Three Moment Theorem can be used to advantage in the graphical calculus solution of many continuous beam problems. However, various methods can be used to obtain the desired answers. The graphical method shown in the above example requires no figuring—just a layout to any suitable scale. The BM_2 slope or deflection at any point can be scaled, as Fig. 1 is oversize for these three diagrams. The slope and deflection must be divided by EI, and also the load and length scales, used to give actual values.

Graphical calculus is not limited to beam problems but can be used to advantage wherever conditions vary, requiring the calculus for a solution.

SOCIETY NEWS

Member Interest Needed, Says President Thomas

Asks Sections' Aid in Solving Financial Problems in Inaugural Address

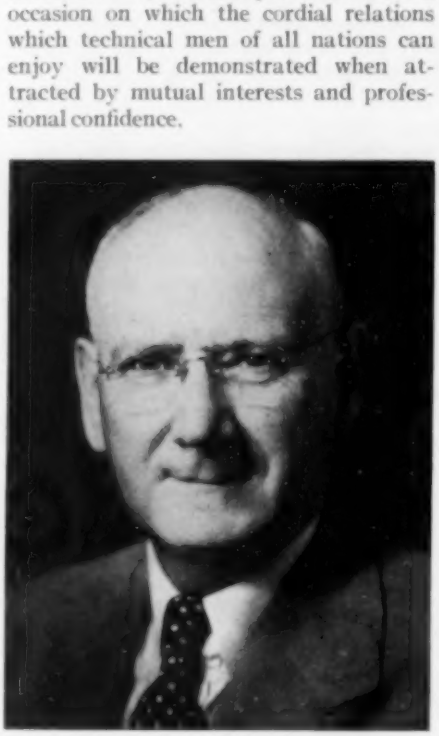
"To one who first identified the blue badge of the American Society of Civil Engineers as it was worn by the chief engineer of the railroad for which the speaker was driving stakes before entering college, and later as a freshman saw it worn by the dean of the college of engineering, the position of the Society has always been an exalted one. As familiarity with the Society, its members, and its functions has developed, respect for the organization has continued to grow while the friendliness of its associations has been increasingly enjoyed.

"I am, therefore, profoundly conscious of the honor represented by the office I assume today, the presidency of the American Society of Civil Engineers. I undertake its duties and responsibilities with humility and also with the hope that I may be able to assist in achieving the objectives of the Society to the benefit and advantage of the civil engineers of this and other lands.

"It is stimulating to review the names of the men who in the years past have occupied the presidency of the Society. It has been my privilege to serve in some capacity and to enjoy association with the presidents of recent years. Each of them made outstanding contributions to the Society in the performance of his duties. I refer to those stalwarts of the engineering profession—Ernest B. Black, Ezra Whitman, Malcolm Pirnie, Jack Stevens, Wesley Horner, Ed Hastings and Dick Dougherty.

"As one looks forward to the year immediately ahead, there are in prospect a number of opportunities to serve our members and engineers in general. It is a year when legislative proposals on a national as well as on state levels may be of extreme importance to engineers. These matters must receive careful attention, although unfortunately the facilities of the Society for handling them are substantially curtailed because of financial limitations created by rising costs of all Society activities in the face of inadequate income.

"The year ahead presents an especial opportunity and challenge to the Society in respect to international relations among engineers. The holding of our Annual Convention next July in the capital of our neighboring republic of Mexico will be an event of great significance. It should prove to be an occasion on which the cordial relations which technical men of all nations can enjoy will be demonstrated when attracted by mutual interests and professional confidence.



FRANKLIN THOMAS
President for 1949

"While attending the International Congress on Large Dams in Stockholm last June, at which 300 engineers representing 22 countries were present, a number of members of this Society heard the thought frequently expressed, 'How fortunate it would be in the interest of world peace if the political leaders of the nations could meet in a spirit of confidence and cooperative friendship such as characterized the international meetings in Stockholm, and later the Soil Mechanics Conference in Rotterdam."

"From the standpoint of the Society, it was gratifying to discover the widespread interest existing among foreign engineers in our Society. Its publications are held in the highest esteem and its members enjoy much prestige. Many highly qualified men were greatly pleased at the suggestion that they might be interested in becoming members. I would like to suggest at this time that much more attention be directed to the possibility of extending our membership among engineers of superior qualifications in countries abroad, and particularly among those who are members of the corresponding societies in their own nations. The approaching convention of the American Society of Civil Engineers in Mexico City might well serve as an opportunity to extend greatly the Society's membership in Latin America.

"Within our own organization, the Board of Direction confronts a situation of great difficulty. Increased costs of maintaining what in the past have been regarded as the essential activities for our satisfactory functioning have compelled some painful retrenchments, such as reduction of publications and cuts in the allotments to Local Sections. These economies the Board was reluctant to impose, but practically all expenditures now purchase less production and service than a few years ago. While more than a majority of those voting have twice expressed a willingness to approve a modest increase in membership dues in order to continue the normal activities of the Society, the proposals fell short of receiving the two-thirds majority required for a constitutional amendment."

"It is indeed regrettable that only 40 percent of our membership voted on so important a question as whether to authorize an adjustment of dues in this extended period of rising costs or to suffer the inevitable alternative, curtailment of benefits and services. This clearly indicates a need for a greater knowledge and interest in Society affairs on the part of many members.

"I hope the Local Sections will act on the suggestion that study and discussion of the Annual Report of the Board of Direction be undertaken in every Local Section. The Sections might well go farther, and undertake to convey the status of Society finances to those members whose attendance at Section meetings is infrequent and whose interest in Society affairs has not been active.

"The problefn of continuing the activities of the Society in the face of inadequate income was not solved by the recent ballot. The problem remains before your Board of Direction, and is more perplexing than ever, since we must seek to continue Society services during an inflationary period without benefit of the additional funds which a dues increase would have

provided. The demands on the Society by its members cover such a wide range that the Board of Direction needs the assistance and interest of every member to help in reaching the proper solution of this problem.

"Active participation in Society affairs, both local and national, by the Local Sections, is the most effective means of obtaining the volume of member interest we must have if the Society is not to retrogress in its efforts to be ever more useful to the membership."

Biographical material about President Thomas is appended to his inaugural statements in order to give the membership a little of the background of the man who heads the Society.

A graduate of the University of Iowa in 1908 with a B.E. degree, Franklin Thomas spent the following year doing graduate work at McGill University. In 1913 he received the C.E. degree from the University of Iowa. In the latter year, following teaching experience at the University of Michigan and work for several public utility organizations, he went as associate professor to the California Institute of Technology to develop the civil engineering department. He became professor of civil engineering in 1915, and from 1924 to 1944 he was chairman of the Division of Civil and Mechanical Engineering, Aeronautics and Meteorology. Since the latter year he has been dean of students.

INCOMING ASCE PRESIDENT FRANKLIN THOMAS (left) presents gavel to outgoing President R. E. Dougherty as memento of his term of office, at Wednesday morning business session, 96th Annual Meeting.

Professor Thomas has been a member of the Board of Directors of the Metropolitan Water District of Southern California since its organization in 1928, and served as vice-chairman of the Board from 1929 to 1947. Appointed a member of the Colorado River Board of California in 1947, he was elected chairman of the Board in 1948. He has also served as a consultant on flood control and sanitation projects for the City of Los Angeles and for Los Angeles and Orange counties.

Long interested in civic affairs, Professor Thomas was a member and vice-chairman of the board of directors of the City of Pasadena from 1921 to 1927. He has also been president of the Pasadena Chamber of Commerce, the Pasadena Community Chest, and the Civic Orchestra Association. For "distinguished service to the city" he was awarded the Arthur Noble Medal for 1939.

A full member of the Society since 1923, Professor Thomas served as Director from District 11 from 1930 to 1933 and as Vice-President from Zone IV in 1944 and 1945. He was a member of the special Committee on Irrigation Hydraulics from 1922 to 1933, and chairman of the Committee on Accredited Schools in 1937. He has also been active in the Los Angeles Section, which he served as president in 1924.

His other affiliations include Sigma Tau, Tau Beta Pi, Sigma Xi, the American Water Works Association, the California Sewage Works Association, and the American Society for Engineering Education.

New Officers Installed and Members Honored at 96th Annual Meeting

A PROGRAM COMBINING traditional ceremonies—installation of ASCE officers and presentation of Society honors and awards—with 17 sessions featuring notable technical and professional papers marked the 96th Annual Meeting. The Technical Division programs are summarized elsewhere in this issue. The three-day meeting, held at the Hotel Commodore, New York City, January 19-21, attracted an attendance of 2,000.

At the Wednesday morning business session, Prof. Franklin Thomas, of Pasadena, Calif., was installed as President of the Society. Excerpts from Professor Thomas' inaugural address, as well as a brief sketch of his career, are given in the preceding item. Also inducted into office were two Vice-Presidents—Henry J. Sherman, Camden, N.J., Zone II, and Robert B. Brooks, St. Louis, Mo., Zone III—and six Directors: Waldo G. Bowman, New York City, and Morris Goodkind, New Brunswick, N. J., District 1; Harold L. Blakeslee, New Haven, Conn., District 2; Paul L. Holland, Baltimore, Md., District 6; Edmund Friedman, Miami, Fla., District 10; and Sidney T. Harding, Berkeley, Calif., District 13.

Conferring of honorary memberships and the award of Society prizes and medals also took place at the Wednesday morning meeting. The new Honorary Members are:

Charles H. Buford, president of the Chicago, Milwaukee, St. Paul and Pacific Railroad, Chicago, Ill.

Lucius D. Clay, lieutenant general, General Staff, U.S.A., military governor of Germany and commander-in-chief of American Forces in Europe.

Donald Derickson, professor of civil engineering, Tulane University, New Orleans, La.

Gano Dunn, president, the J. G. White Engineering Corp., New York, N.Y.

Andrew Weiss, construction engineer, National Commission of Irrigation, Mexico City, Mexico.

The twelve engineers who received prizes and medals for their outstanding contributions to Society publications are:

Norman Medal, Alfred M. Freudenthal, M. ASCE, consulting engineer, New York, N. Y.

J. James R. Croes Medal, Karl de Vries, M. ASCE, Bridge Design Department, Bethlehem Steel Co., Bethlehem, Pa.

Thomas Fitch Rowland Prize, M. M. FitzHugh, plant engineer, Newport News Shipbuilding and Dry Dock Co., Newport News, Va.; James S. Miller, senior vice-president and director, Dravo Corp., Pittsburgh, Pa.; and Karl Terzaghi, Hon. M. ASCE, professor of the practice of civil engineering, Harvard University Graduate School of Engineering.

James Laurie Prize, Hyde Forbes, M. ASCE, consulting engineer, Palo Alto, Calif.

Arthur M. Wellington Prize, Joseph Barnett, M. ASCE, chief, Urban Road Division, Public Roads Administration, Washington, D.C.

Collingwood Prize for Juniors, John K. Vennard, Assoc. M. ASCE, associate professor of fluid mechanics, Stanford University.

Rudolph Hering Medal, C. E. Jacob,

Assoc. M. ASCE, head of the Department of Geophysics, University of Utah.

J. C. Stevens Award, Preston T. Bennett, M. ASCE, Design Branch, Omaha District, Corps of Engineers.

Construction Engineering Prize, C. Glenn Cappel, Director, ASCE, member of firm of W. Horace Williams Co., New Orleans, La.

Leon S. Moisseiff Award, George Winter, M. ASCE, head of the Department of Structural Engineering, Cornell University.

Wednesday Luncheon Meeting

The United States must lead the way in achieving a united world, under the United Nations, Wallace K. Harrison, director of planning for the UN headquarters, told ASCE members in the keynote address presented at the Wednesday luncheon meeting. Stating that the present world situation is "a challenge to every free citizen" and that government alone cannot meet the challenge, Mr. Harrison stressed the fact that "we must offer other nations our mass techniques," our engineering and construction resources. American engineering and business achievement in South America, notably Venezuela and Brazil, in the past decade, was cited as an effort in the right direction.

Referring to his experience as director of planning for the new UN Headquarters, in which capacity he headed groups of engineers and architects from all over the world, Mr. Harrison stated that the complete cooperation of 15 different nations, obtained in planning the project, emphasizes the international aspects of science and engineering.

The dominating structure of the UN Headquarters project, now under construction on the East River in mid-town Manhattan, is a $23,000,000 air-conditioned skyscraper secretariat. This building, Mr. Harrison said, will have a capacity of 3,200 persons, with the possibility of expansion up to 4,200. Completion is scheduled for early in 1950. The secretariat building will service the Councils and Assembly buildings, the next two units to be constructed.

Special Events

Other events attracting special attention included the annual Wednesday evening dinner dance in the ballroom of the Commodore; the Thursday luncheon, at which the Construction Division sponsored a panel discussion of construction prospects for 1949 by experts in the field; a smoker and entertainment for the men on Thursday evening; and an inspection trip on Saturday morning to the new 26th Ward Sewage Treatment Works in Brooklyn. During the entire meeting week, engineering alumni and fraternity groups took the opportunity to schedule dinners and other reunions.

EXECUTIVE COMMITTEE in charge of arrangements for ASCE Annual Meeting included left to right front row, Nomer Gray, John P. Riley, Maurice N. Quade, J. M. Garrelts, and John M. Buckley. Vacant chair was intended for Edward J. Cleary, general meeting chairman, who was ill and unable to be photographed. Standing, left to right, are Horace A. Vanderbeek, William S. LaLonde, Jr., Raymond L. Brandes, Eugene M. Itjen, Ralph S. Angell, Irving F. Ashworth and Charles B. Molineaux. On committee, but not shown, were Ford Bartlett, Ralph Atwater, and William McK. Griffin.

MEMBERS OF LADIES COMMITTEE meet with William S. LaLonde, Jr., chairman of Ladies Entertainment Committee, to plan social events for wives of engineers attending Annual Meeting. Seated, left to right, are Mrs. John P. Riley, vice-chairman of Ladies Committee, Mrs. M. N. Quade, Mrs. Alfred Hedefine, Mrs. Edward J. Cleary, chairman of Ladies Committee, Mrs. Morris Goodkind, Mrs. Charles E. Trout, and Mrs. William N. Carey. Standing in same order, are Mrs. Roger W. Armstrong, Mrs. Raymond L. Brandes, Mrs. William S. LaLonde, Professor LaLonde, Mrs. Charles B. Molineaux, Mrs. Ford Bartlett, Mrs. Horace Vanderbeek, Mrs. Eugene M. Itjen, and Mrs. Nomer Gray.

Joint Sanitary Engineering Sessions

The Sanitary Engineering Division, which held three regular sessions, also cooperated with the American Water Works Association and the New York State Sewage Works Association in an all-day meeting at the Hotel Pennsylvania on Friday. Diverse phases of water and waste treatment were covered at these joint sessions, which represented the first large-scale cooperation of the three societies. A social hour, arranged by the Water and Sewage Works Manufacturers Association, concluded the all-day program. The papers read at these sessions are summarized elsewhere in the issue

Student Chapter Conference

About 300 students from engineering colleges in the East attended the Metropolitan Conference of Student Chapters on Friday afternoon, which featured a brief address by President Thomas on the Society in its relationship to the engineering student. Also of interest was a forum on job opportunities in civil engineering. The three fields of civil engineering represented were stress analysis in aircraft, discussed by S. F. Borg, assistant professor of aeronautics, U. S. Naval Postgraduate School, Annapolis; traffic engineering, covered by Leslie Williams, New York consultant; and design and construction of petroleum refining equipment, described by Herbert Schuster, chief designer, M. W. Kellogg Co. The final feature of the afternoon was a general discussion of Student Chapter affairs.

Principal Board Actions Abstracted, Annual Meeting

New York, N.Y., January 17–20

Lapel Pin Authorized

A small Society emblem suitable for lapel wear, shown here, was authorized for addition to the approved Society jewelry. The new lapel pin is a small blue shield $^3/_8$ in. high with buttonhole fastener. It bears the letters ASCE.

Reorganization of District and Zone Structure Under Study

A proposal for basic changes in the organization of the Society was given serious consideration by the Board of Direction at the January 1949 meeting. An Organization Study Committee, headed by Arthur W. Harrington, of Albany, N.Y., a former Vice-President of the Society, and including two past or present Board members from each of the four Zones, submitted a report on the matter in accordance with instructions by the Board at the October 1948 meeting. The general objective of the Committee's study was to recommend practical ways and means by which the work of the Local Sections and their members could be integrated more closely with the operations of the Board of Direction.

The basic recommendation of the Committee was that the Society Districts as now constituted should be abolished in favor of a regional organization, the country being divided into five or more regions. The Board directed that the report of the Organization Study Committee be transmitted to each Local Section for its information. The Board also instructed the Committee to continue its studies looking to further recommendations along regional organization lines to be made at the next meeting of the Board.

Technical Publications, Procedures and Costs

A report made by the Special Committee on Technical Publications, Procedures and Costs stimulated extended discussion. This Committee, of which George W. Burpee, is chairman, and Shortridge Hardesty, former chairman of the Publications Committee, is vice-chairman, has had the subject of procedures and costs of technical publications under study for several months. The study included a questionnaire sampling of 1,000 members of the Society. The Committee's progress report discussed at length the views obtained through the questionnaires. The Committee also reported on its study of the technical publications procedure by our sister societies. The general drift of the progress report appeared to be in the direction of an ultimate recommendation for the retention of TRANSACTIONS as now published and for some type of separate publication of PROCEEDINGS papers. Final action on the matter was not taken, and the Committee was instructed to continue its study, in cooperation with the Local Sections, and to submit another report at the next Board meeting.

Annual Report Approved

The 1948 Annual Report of the Board of Direction, a printed booklet of 28 pages, was approved by the Board. A summary of the 1948 Annual Report of the Board of Direction appears elsewhere in this issue.

Manuals Ordered Printed

The Board authorized the printing of a Hydrology Manual, now in manuscript form. The proposed handbook is to be sold to members at cost, and to nonmembers at a higher price. The printing of a Glossary on Water and Sewage Control Engineering also was authorized. This glossary is the result of cooperative effort on the part of ASCE and three other organizations, all participants having agreed that the glossary when printed would be made available to members at the price of $1.00 per copy, the cost of printing and mailing. The considerable cost of bringing the manuscript to a ready-to-print stage already has been covered in the respective budgets of the participating societies.

Summer Convention Plans

It was reported to the Board that plans for the program of the Summer

INCOMING BOARD OF DIRECTION assembles for its first meeting. Beginning at left corner of table and proceeding clockwise around table are shown: Morris Goodkind, Director, District 1; Franklin Thomas, President; Paul L. Holland, Director, District 6; Webster L. Benham, Director, District 14; Roy W. Crum, Director, District 5; E. M. Hastings, Past-President; Edmund A. Prentis, Director, District 1; Carlton S. Proctor, Vice-President, Zone I; R. E. Dougherty, Past-President; C. Glenn Cappel, Director, District 15; William N. Carey, Executive Secretary; Joel D. Justin, Director, District 4; John W. Cunningham, Vice-President, Zone IV; William McK. Griffin, Director, District 1; W. L. Malony, Director, District 12 (at table); Daniel V. Terrell, Director, District 9; David L. Erickson, Director, District 16 (at table); Julian Hinds, Director, District 11; Robert B. Brooks, Vice-President, Zone III (at table); Harold L. Blakeslee, Director, District 2; Edmund Friedman, Director, District 10 (at table); Sidney T. Harding, Director, District 13; Henry J. Sherman, Vice-President, Zone II.

Convention at Mexico City are developing satisfactorily under the supervision of a special Mexico meeting committee headed by Charles M. Upham, M. ASCE, of Washington, D.C. The Board emphasized the fact that the Mexico City meeting will be no more expensive as far as the Society is concerned than if the Summer Convention were being held in some Western section of the United States, as is customary. At the time the Mexico City meeting was scheduled the Board agreed that the Society would not pay mileage allowance to Board members or committee members attending the meeting for distances traveled outside the continental limits of the United States.

Committees Appointed

The newly installed President, Franklin Thomas, of Pasadena, Calif., announced the appointment of committees of the Board of Direction and certain standing committees. The Board concurred in these appointments. The membership of the committees of the Board for the year 1949 follows.

Committees of Board

EXECUTIVE COMMITTEE: Franklin Thomas, *Chairman;* Carlton S. Proctor, *Vice-Chairman;* R. E. Dougherty, Henry J. Sherman, E. M. Hastings.

COMMITTEE ON DISTRICTS AND ZONES: John W. Cunningham, *Chairman;* Carlton S. Proctor, *Vice-Chairman;* Robert B. Brooks, Henry J. Sherman.

COMMITTEE ON DIVISION ACTIVITIES: John W. Cunningham, *Chairman;* Henry J. Sherman, *Vice-Chairman;* Joel D. Justin, Lewis M. Gram, Roy W. Crum.

COMMITTEE ON HONORARY MEMBERSHIP: Franklin Thomas, *Chairman;* E. M. Hastings, *Vice-Chairman;* R. E. Dougherty, John W. Cunningham, Carlton S. Proctor, Robert B. Brooks, Henry J. Sherman.

COMMITTEE ON MEETINGS: John W. Cunningham, *Chairman;* Robert B. Brooks, *Vice-Chairman;* Carlton S. Proctor, Henry J. Sherman.

COMMITTEE ON MEMBERSHIP QUALIFICATIONS: W. M. Griffin, *Chairman;* D. L. Erickson, *Vice-Chairman;* W. L. Malony, J. H. Hinds, Harold L. Blakeslee, Edmund Friedman.

COMMITTEE ON PROFESSIONAL CONDUCT: H. C. Woods, *Chairman;* C. Glenn Cappel, *Vice-Chairman;* Samuel A. Greeley, Morris Goodkind.

COMMITTEE ON PUBLICATIONS: Roy W. Crum, *Chairman;* Waldo G. Bowman, *Vice-Chairman;* D. V. Terrell, E. A. Prentis, Joel D. Justin, Sidney T. Harding.

Standing Committees

COMMITTEE ON ENGINEERING EDUCATION: W. J. Armento, *Chairman* (1950); Hale Sutherland, *Vice-Chairman* (1951); C. E. DeLeuw (1952), Frank Kerekes (1953), D. V. Terrell, *Contact Member* (1950).

COMMITTEE ON REGISTRATION OF ENGINEERS: T. K. Legare, *Chairman* (1950); Leo Odom, *Vice-Chairman* (1951); D. B. Steinman (1952), Thomas C. Shedd (1953), Morris Goodkind, *Contact Member* (1950).

COMMITTEE ON PRIVATE ENGINEERING PRACTICE: R. N. Bergendoff, *Chairman* (1951); C. A. Emerson, Herschel H. Allen (1950); N. T. Veatch (1952); Francis Friel, *Vice-Chairman* (1953); Webster L. Benham, *Contact Member* (1950).

COMMITTEE ON SALARIES: A M Rawn, *Chairman* (1951); R. A. Munroe (1953); J. B. Akers (1952); T. H. Evans (1950); Paul L. Holland, *Contact Member* (1950).

COMMITTEE ON JUNIORS: E. E. Lustbader, *Chairman* (1950); D. W. Godat, *Vice-Chairman* (1951); John Girand (1952); Harry F. Thomson (1953); W. L. Benham, *Contact Member* (1950).

COMMITTEE ON LOCAL SECTIONS: F. C. Scobey, *Chairman* (1950); T. C. Hanson, *Vice-Chairman* (1951); P. A. Rice (1952); C. A. Yoder (1953); H. C. Woods, *Contact Member* (1950).

COMMITTEE ON STUDENT CHAPTERS: C. P. Hazelet, *Chairman* (1950); F. B. Laverty, *Vice-Chairman* (1951); R. A. Marr, Jr. (1951); J. M. Faircloth (1952); D. M. Griffith (1952); R. H. Dodds (1953); D. V. Terrell, *Contact Member* (1950).

Two Regional Offices Closed

Final reports from the Midwest and Western Representatives of the Society, whose offices were closed as of December 31, 1948, were received by the Board. The Board passed a resolution expressing to George S. Salter, of Chicago, and Walter E. Jessup, formerly of Los Angeles and now editor of CIVIL ENGINEERING, the Board's appreciation of the excellent work done by them as field representatives in the interest of ASCE.

The Executive Secretary reported that the Washington office is being maintained and that Joseph H. Ehlers, M. ASCE, of Washington, D.C., has been engaged to devote about half of his time to the duties of the office of Eastern Representative.

Cooperation with Other Engineering Groups Studied

The continued study to develop principles, preferred methods, and details of cooperation was recommended by the Society's Committee on Cooperation with Engineering Groups.

Budget Committee Reports Small Surplus

The Board received with pleasure the report by the Budget Committee, of which George W. Burpee, M. ASCE, is chairman, that changes recommended in the budget for the first quarter of the fiscal year appear to leave the Society with an estimated surplus of $4,050 income over estimated expenditures for the rest of the year. The Board voiced formal appreciation of the work of the Budget Committee.

Financial Stringency Stressed by Secretary in Summarizing 1948 Annual Report

SUMMARIZING THE ANNUAL Report for 1948, copies of which were distributed to those present, Col. William N. Carey, Executive Secretary, ASCE, had the following to say at the opening business session of the 96th Annual Meeting:

"Rather than take the time to read to you the entire Annual Report, I should like to call attention of the membership to its highlights. This report covers the second successive fiscal year in which finances were the most pressing problem of the ASCE.

"The fiscal year which ended September 30, 1948, found us 'in the black' but only because of necessary curtailment of customary services and a reduction in Local Section allotments. (A graphic presentation of the fiscal operations of ASCE, for the past fiscal year is shown in the accompanying chart.)

In view of the continuation of rapidly rising costs and the fact that the proposed Constitutional Amendment to increase dues failed to pass in October of 1947, and failed again last October, the curtailments inaugurated a year ago must be continued and extended.

"Our 1949 budget could not provide the funds necessary for operation of the Society's three regional offices, in Washington, D. C., Chicago, and Los Angeles. Consequently, the Chicago and Los Angeles offices were closed as of December 31, and we are reducing our activities in the Washington office to a minimum con-

sistent with protecting the ASCE interest in national affairs.

"So tight is our financial status—with anticipated operating expenses equaling, within $2,100, our expected income of $724,150—that the Board was forced to continue Local Section allotments on the same reduced formula adopted a year ago. The formula still is: $50 for each Section, plus $1 for each member paying Local Section dues. However, allowance for Local Section representatives attending Local Section conferences has been restored to the full mileage allowance, instead of half the allowance to which it was reduced last year.

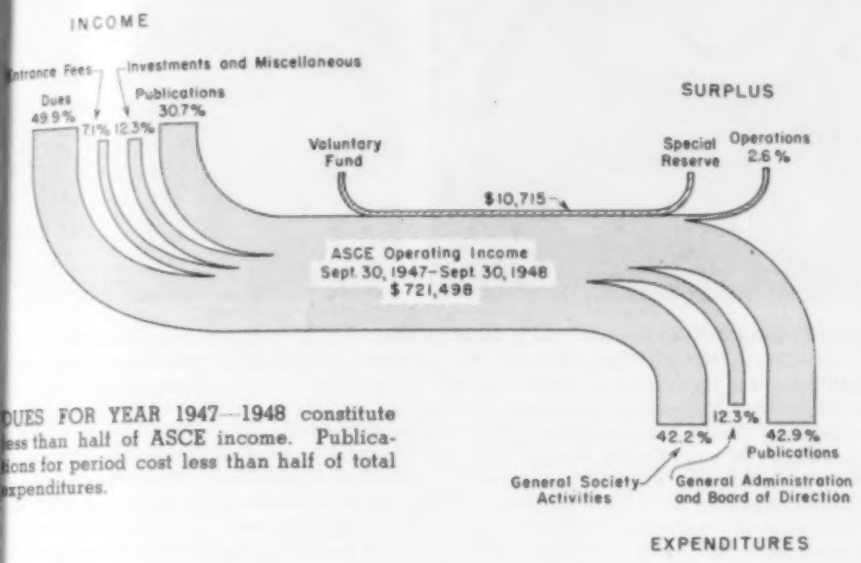
"In the field of technical publications—the largest single item of Society expenditure—prices continue higher and higher and still higher. For example, as little as five years ago, our expenditure for technical publications, exclusive of CIVIL ENGINEERING, was $72,000 as against $110,000 spent for the same items in 1948, a rise of 50 percent. Changes are indicated in our publications policy, in order to permit the Society to continue technical publications. A special committee is studying this problem. The printing of a Yearbook was skipped in 1948 with the hope that one could be published in 1949. The present estimated cost of a full-scale Yearbook is $35,000. The Board was able to budget $15,000 to meet the Yearbook needs.

"In the Voluntary Fund, all but $600 of the $10,715 collected last year remains intact, and the fund has been continued with the hope that the Voluntary Fund, untouchable except by specific order of the Board for some special or urgent purpose, will develop into a dependable cash cushion, since it seems impossible to provide otherwise for such a reserve, essential in the conduct of any business.

"It is gratifying to report that, despite these curtailments in services and activities, our Society now has the largest membership in its history. As of September 30, the membership was 23,977, and it is well over 24,000 now. Much of the increase is in the grade of Junior, and that poses a problem both as to Society finances and the kind and degree of service desired by this fast-growing grade of membership. Dues paid by most Juniors are $10.00, just half of most Corporate Member dues. Our new Juniors, however, are rather clearly indicating that they want and expect much more from their professional Society than its technical publications. These and allied problems are under continuous study by the Board of Direction and its Committees. Satisfactory solutions are being sought within the limits of the present financial handicap, and both within and without the traditional framework of our organization.

"Other phases of this Annual Report cover the Society's activities in conjunction with other professional organizations, and offer the interested member an insight into the widespread workings of his and other engineering groups. Copies of the Annual Report are being dispatched to the presidents and secretaries of all the Local Sections, with the suggestion that they, or a Section committee, digest the report for presentation and full discussion at a Section meeting.

"The contents of the report, covering as they do the critical times through which we are passing, merit the interest and attention of every member."



DUES FOR YEAR 1947—1948 constitute less than half of ASCE income. Publications for period cost less than half of total expenditures.

Tellers Report on Final Ballot for 1949 Officers

To the Ninety-Sixth Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to canvass the Ballot for Officers of the Society for 1949 report as follows:

For President:

Franklin Thomas	8,411
Scattering	16
Blank	15

For Vice-Presidents:

Zone II

Henry John Sherman	8,384
Scattering	5
Blank	53

Zone III

Robert Blemker Brooks	8,378
Scattering	9
Blank	55

For Directors:

District 1 (two to be elected)

Waldo Gleason Bowman	8,375
Morris Goodkind	8,346
Scattering	8
Blank	155
Total Votes registered	16,884
Total Ballots canvassed	8,442

District 2

Harold Law Blakeslee	8,400
Scattering	0
Blank	42

District 6

Paul Leach Holland	8,400
Scattering	1
Blank	41

District 10

Edmund Friedman	8,373
Scattering	12
Blank	57

District 13

Sidney Twichell Harding	8,402
Scattering	4
Blank	36

Ballots canvassed	8,442
Ballots withheld from canvass without signature	131
Total number of ballots received	8,573

Respectfully submitted,

JAMES D. PARSONS, *Chairman*
MILTON O. ELKOW, *Vice-Chairman*

E. P. Albright — Thomas K. A. Hendrick
F. B. Forbes — Sherman Glass
H. F. Hormann — Thomas R. Kuesel
W. H. Dieck — Frederick W. Ockert
H. C. Lamberton, Jr.

(Tellers)

SCENES FROM WEDNESDAY MORNING BUSINESS SESSION at recent Annual Meeting show ASCE members being honored for outstanding contributions to profession. In view at left Charles Metcalf Allen, for many years professor of hydraulic engineering at Worcester Polytechnic Institute, (left in photo), receives 1949 John Fritz Medal from D. Robert Yarnall, chairman of John Fritz Medal Board of Award. Professor Allen is honored for "exceptional achievement in hydraulic engineering," and as "the founder of a notable hydraulic laboratory; prominent teacher, consultant, inventor, and author." Retiring President Dougherty is in speaker's stand. At left, in center photo, ASCE Past-President Malcolm Pirnie, New York City consultant, receives Hoover Medal from Scott Turner, chairman of Hoover Medal Board of Award, in recognition of his work toward achieving recognition for engineering profession in solution of national and international problems. Mr. Pirnie is cited as "Engineer, leader of engineers and servant of his fellow man, whose ideals and accomplishments in public life beyond the call of his profession have benefited men in his own and other countries of the world." First presentation of Moisseiff Award is made to George Winter, professor of structural engineering at Cornell University (left in photo at right) by Shortridge Hardesty, chairman of committee that established award, for paper on "Strength of Thin Steel Compressive Flanges."

Past-President Pirnie Addresses Local EJC Organizational Meeting

ENGINEERS CANNOT BE isolationists, Malcolm Pirnie, Past-President of ASCE, and chairman of the Engineers Joint Council Committee on the Technological Disarmament of Germany and Japan, told 200 Wisconsin engineers at a recent joint meeting of the Wisconsin Section of the ASCE and the Milwaukee sections of the AIEE and ASME, held in Milwaukee. Mr. Pirnie said in part that, in the present century, research discoveries in fundamental and applied science have developed new forces, materials, and machines, which may destroy civilization before it can be informed how to use them wisely for universal benefit. The engineering profession, he added, has been so engrossed in these exciting developments that it has given little thought to planning comparable developments in general education and human relations to make beneficial use of these discoveries.

"Engineers understand many and respect all of the laws of nature," Mr. Pirnie stated. "Their lives are devoted to the use of known laws, with factors of safety selected to respect unknown laws, in building structures and machines for the convenience and benefit of all. For most fruitful development, a climate of complete freedom of thought and action is essential. Every engineering project is a laboratory demonstrating coordinated individual freedom of thought and action. Thus the engineering profession is fundamentally qualified to demonstrate the benefits of free enterprise by ministering abroad to the advancement of standards of living there. An articulate organization of the profession, adequately supported by all of its members, is imperative if we are to do our duty creditably in the long struggle that lies before us. We cannot escape being among the indispensable leaders in the struggle."

Speaking particularly of EJC and its accomplishments, Mr. Pirnie pointed out that there are about 100,000 members of the national societies and institutes of engineers representing the five generally recognized distinct branches of the engineering profession. "At least twice, and possibly three times, as many engineers are qualified for membership in some grade in the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers or the American Institute of Chemical Engineers," he said.

"These five national organizations have created Engineers Joint Council, now consisting of the two most recent available past-presidents and the secretary of each. EJC has recommended and is carrying out policies and activities approved by the boards of directors of its constituent societies. Together, with the American Society for Engineering Education, EJC has served the profession and the government by focusing studies by qualified engineers on national and international problems. Such accomplishments and studies now in progress deserve the enthusiastic support of every engineer."

It is Mr. Pirnie's belief that the least an engineer can do toward paying his debt to society is to become a member of that national organization of engineers, which represents his chosen major branch of the profession, and contribute to the financial support of the organization in its ministry to the profession and the public. He recommended that each engineer support movements to adjust the dues of his engineering organization in order to pay current costs of present services and their needed expansion.

To the solution of international and national problems qualified engineers have given generously of their time as individuals and on task committees appointed by EJC, Mr. Pirnie stated. These include:

1. Membership in the United States delegation for the United Nations Educational, Scientific and Cultural Organization (UNESCO).

2. Service on the National Engineers Committees appointed by request of the Departments of State and War, to report on the Industrial Disarmament of Germany and of Japan. The Economic Cooperation Administration officials in Washington and Europe are consulting the National Engineers Committee periodically in their search for qualified personnel and other engineering services.

3. The Committee on International Relations is cooperating with similar

organizations of engineers in South America and Europe and has procured and shipped books to restock devastated libraries around the world.

4. "The Engineering Profession in Transition," an EJC report prepared by Andrew Fraser, consultant, under the direction of the Committee on the 1946 Survey of the Engineering Profession from questionnaires distributed and analyzed by the Bureau of Labor Statistics, is an authoritative document presenting the economic status of the engineer from the depression, through World War II, to the period of postwar readjustment. This report, Mr. Pirnie believes, is of great value to educators, to engineers in private practice, and to employers of engineers.

5. The EJC Manual on Collective Bargaining was presented by a panel of representative engineers appearing by request at a hearing of the House Committee on amendments to the Wagner Act. As a result, an acceptable definition of the term "professional employee," and a provision that such an employee cannot be forced to join non-professional employees for the purpose of collective bargaining were included in the Taft-Hartley Act. "These provisions are there," Mr. Pirnie stated, "because engineers studied the problem and presented their conclusions in simple and uncontroversial language."

6. Other EJC committees are studying the best utilization of engineers in the unified armed forces in time of peace and in time of war. A committee meets with the Director of Selective Service. Two committees are studying national water and fuel policies. A committee is advisory to the U.S. Civil Service Commission. Such activities are directed to planning for maximum use in future emergencies of the scarce and essential skills of engineers.

In closing, Mr. Pirnie stated that the engineering profession is awakening to its capacities and responsibilities in national and international affairs. "It has limitless potentialities in the struggle to preserve the freedoms that have made our country strong and prosperous and to preserve and strengthen individual freedom abroad."

During the open forum following Mr. Pirnie's address, members of the various engineering groups present discussed organization of a Milwaukee engineering council and a local program of accomplishment for it. Engineering councils, which bring together local members of national and local engineering societies are functioning effectively in other localities—among them Denver, San Francisco, Los Angeles, San Diego, Baltimore, Virginia, Oregon, and the Puget Sound area.

California Sections Set San Diego for Second Annual Convention

THE SECOND ANNUAL Convention of Western members of ASCE will be held Friday and Saturday, March 25–26, at the U.S. Grant Hotel, San Diego, Calif. Participating will be the four California Local Sections—Sacramento, San Francisco, Los Angeles, and San Diego—and their seven sponsored Student Chapters. Special invitations to all Western members have been issued through the secretaries of other Zone IV Local Sections. The General Committee in charge of the Convention is composed of M. J. Shelton, chairman, 8710 Hayes Street, La Mesa, Calif.; Ray L. Derby, Los Angeles; Albert G. Mott, Sacramento; and L. A. Elsener, San Francisco.

Registration, beginning on Thursday afternoon, will be followed by a pre-convention get-together in the Gold Room of the hotel. Friday is set aside for registration of late arrivals; the presentation of technical papers of particular interest to Western engineers; a Student Chapter paper competition; a student business meeting; and a special banquet, at which two prize-winning student papers will be presented by their authors. ASCE President Franklin Thomas will address the banqueters.

Features of the Saturday part of the program include a general business session; a luncheon for the men and ladies to be served aboard a San Diego Harbor excursion boat, from which the group will inspect harbor facilities; and a field trip by bus to points of engineering interest. Deep-sea fishermen will be accommodated on Sunday by members of the local committee.

EJC Labor Legislation Panel Appointed

AS NOTED IN the December issue of CIVIL ENGINEERING, a special panel has been organized under auspices of Engineers Joint Council to take appropriate steps toward maintaining existing provisions relative to professional employees in the labor law.

The Panel is constituted as follows: EJC reappointed as chairman, E. Lawrence Chandler, Assistant Secretary ASCE, New York; ASCE reappointed Gail H. Hathaway, special assistant to the Chief of Engineers, Washington, D.C.; AIME named Francis B. Foley, superintendent of research, the Midvale Co., Philadelphia; ASME reappointed Wm. F. Ryan, assistant engineering manager, Stone & Webster Engineering Corp., Boston; AIEE named E. H. Bancker, application engineer, General Electric Co., Schenectady; AIChE reappointed W. I. Burt, vice-president, B. F. Goodrich, Chemical Co., Cleveland; and NSPE named John S. Kennedy, Shaker Heights, Ohio. An invitation has been extended to ASEE to appoint a representative to the Panel.

Owing to uncertainties as to the procedure to be followed by Congress in connection with the Taft-Hartley (Labor-Management Relations) Act, the course of action to be adopted by the Panel has not been charted in detail. If the "two-package" program urged by labor unions is followed, the Taft-Hartley Act would be repealed and the old Wagner Act reinstated. This would mean that professional employees would once more be thrown into the turmoil, in which they were engulfed for twelve years, and it would be necessary to do over all of the work entailed in establishing the current legislative provisions that have permitted such employees to gain independence from domination by labor unions against their wishes.

On the other hand, the essence of a "one-package" program would be to amend the Taft-Hartley Act as it now stands on the statutes. The objective of the new EJC Panel will be to recommend simply that the professional provisions of the Act should not be tampered with.

Reinstatements and Resignations Listed

SINCE PUBLICATION OF membership applications, additions and transfers in CIVIL ENGINEERING has been discontinued by recent action of the ASCE Board of Direction, reinstatements and resignations will be given in "Society News." The current list follows:

Reinstatements

ELDRIDGE, ALBERT MATTHEWS, Assoc. M., Design Engr., City of Austin, 2nd & Nueces (Res., 1509 Elton Lane), Austin, Tex., reinstated Jan. 1, 1949.

WILSON, MAYBIN HOMES, M., Col., Corps of Engrs., U.S.A., Military Dept., Univ. of Tex., Austin, Tex., reinstated Jan. 1, 1949.

TOTAL MEMBERSHIP AS OF JANUARY 10, 1949

Members	7,239
Associate Members	9,368
Corporate Members	16,607
Honorary Members	44
Juniors	8,160
Affiliates	72
Fellows	1
Total	24,884
(January 9, 1948	22,586)

Resignations

ABONY, ERWIN, Jun., Designer-Draftsman, Combustion Eng. Co., 200 Madison Ave., New York (Res., 80 Grant Dr., East Valley Stream, L.I.), N.Y., resigned Dec. 28, 1948.

BIESACK, STANLEY ROBERT, Jun., Engr., Truscon Eng. & Sales Office, 19th & Grove Sts. (Res., 1006 Garnett Ave.), Chattanooga, Tenn., resigned Dec. 15, 1948.

BRAUER, LYNN ALLEN, Jun., Lt. (jg) CEC, USNR, 6076 Newburg Ave., Chicago, Ill., resigned Dec. 11, 1948.

BRENNAN, WILLIAM ANDERSON, M., Civ. Engr., R.F.D. Route 1, Litchfield, Conn., resigned Nov. 19, 1948.

BROWN, CHARLES FRANKLIN, Jun., Engr. Asst., Southern Calif. Gas Co., 1700 So. Santa Fe Ave., Los Angeles (Res., 5030 West 122nd St., Hawthorne), Calif., resigned Dec. 29, 1948.

BURGESS, TURNER P., Jun., Draftsman, A.T. & S.F. Rwy. Co., General Office Bldg. (Res., 624 Oakley), Topeka, Kans., resigned Dec. 28, 1948.

DOUGLAS, LAWRENCE M., Jun., Appraisal Engr., 582 Market St., San Francisco, Calif., resigned Dec. 3, 1948.

FOWLER, FRED TRACY, M., Traffic Engr., City of Portland, 407 City Hall (Res., 8040 So. East 35th Ave.), Portland, Ore., resigned Dec. 22, 1948.

GIANNOTTI, ALFRED, Jun., Struct. Des., Constr. and Design Dept., Linde Air Products, 205 East 42nd St. (Res., 144—16 Thirty-fifth Ave., Flushing), N.Y., resigned Dec. 4, 1948.

HALLDEN, OTTO S., Jun., 116 West South St., Mt. Sterling, Ill., resigned Dec. 6, 1948.

HOLLER, ARTHUR FOX, Assoc. M., Care, Standard Oil Co., 30 Rockefeller Plaza, New York, N.Y., resigned Dec. 22, 1948.

HOPKINS, ELMER WOODSON, M., San. Engr., Mission Township (Johnson County, Kansas), San. Sewer Dist., 4706 Broadway (Res., 533 Gladstone Blvd.), Kansas City, Mo., resigned Dec. 16, 1948.

KELLY, WARREN WINFIELD, M., Gen. Purchasing Agent, A.T. & S.F. R.R., 80 East Jackson St., Room 925, Chicago, Ill., resigned Dec. 10, 1948.

KINDINGER, MARTIN, Assoc. M., Summer Hill, P.O. Donkerpoort, Orange Free State, Union of South Africa, resigned Dec. 31, 1948.

KULAS, FRANK EDWARD, Assoc. M., Cost Engr., Eastman Kodak Co., 333 State St. (Res., 400 Wimbledon Rd.), Rochester, N.Y., resigned Dec. 31, 1948.

LARSON, EWALD CLAUS, Jun., Assoc. Engr., Manhattan Engr. Dist., Albuquerque (Res., Box 1706, Sante Fe), N.Mex., resigned Dec. 28, 1948.

LEVITAN, PHILIP W., Jun., 817 West End Ave., New York, N.Y., resigned Dec. 8, 1948.

LINTON, GEORGE EDGAR, Assoc. M., Civ. Engr., U.S. Engr. Office, 628 Pittock Block (Res., 4030 So. West 58th Ave.), Portland, Ore., resigned Dec. 22, 1948.

MCFARLAND, CECIL WARREN, Jun., Ens., 5th N.D., P.W.D., Norfolk, Va., resigned Nov. 30, 1948.

NEFF, PAUL EMIL, Jun., Lt. Col., Signal Corps, U.S.A., 1409 West Ave., New York, N.Y., resigned Dec. 27, 1948.

NEWMARK, HERBERT LEONARD, Jun., Junior Engr., American Bridge Co., South Warren (Res., 850 Parkside Ave.), Trenton, N.J., resigned Dec. 28, 1948.

NOBLE, WILLIAM H., Assoc. M., 118 West Lambert Rd., Whitter, Calif., resigned Dec. 6, 1948.

PRACY, GEORGE WESLEY, JR., Jun., Engr. Asst. to Maintenance Foremen, Standard Oil Co. of Calif. (Res., P.O. Box 609, Maricopa), Calif., resigned Dec. 22, 1948.

PRANGE, HERBERT LOUIS, Assoc. M., Supervisor, Alvin Wunderlich Lumber Co. (Res., P.O. Box 166), Caruthersville, Mo., resigned Dec. 22, 1948.

RUNDE, HOWARD NORMAN, Jun., Engr., Joseph Schlitz Brewing Co. (Res., 1953 No. 85th St.), Milwaukee, Wis., resigned Dec. 28, 1948.

SCHWARTZENHAUER, ARTHUR GEORGE, Assoc. M., With Univ. of Ore. Dental School (Res., 1707 No. East 28th Ave.), Portland, Ore., resigned Dec. 28, 1948.

STOREY, RICHARD WATSON, Jun., Asst. Engr., U.S. Coal & Coke Co., Lynch (Res., Jenkins), Ky., resigned Dec. 8, 1948.

SWATTA, FRANK ALBERT, Jun., Lt. Col., Corps of Engrs., U.S.A., Engr. Center, Fort Belvoir, Va., resigned Dec. 22, 1948.

RAPP, HENRY CLINTON, Assoc. M., Supt., Limestone Dept., Saltville Operations, The Mathieson Alkali Works, Inc., Saltville, Va., resigned Dec. 4, 1948.

ROSTRON, CHARLES RICHARD, Assoc. M., Struct. Designer, Chf. Engrs' Office, S.P. Lines, 916 Southern Pacific Bldg., Houston (Res., Almeda), Tex., resigned Dec. 28, 1948.

TAGGART, WILLIAM NAGELE, Jun., Supervisor of Track, Pennsylvania R.R., Weston & Ionia (Res., 635 Dickenson S.E.), Grand Rapids, Mich., resigned Dec. 22, 1948.

THOMAS, ERVIN LINWOOD, Jun., Maj., Corps of Engrs., U.S.A., 524 Engr. Battalion, Army Post Office, 777, Care, Postmaster, New York, N.Y., resigned Dec. 28, 1948.

THOMPSON, CHARLES EVERETT, Jun., Engr., International Boundary Comm., First National Bank Bldg. (Res., Route 2, Box 97), El Paso, Tex., resigned Dec. 22, 1948.

TRUDEAU, JOSEPH RAYMOND MARC, Jun., Des. Engr., Lalonde & Valois (Res., 6388 Delorimier St.), Montreal, Que., Canada, resigned Dec. 29, 1948.

TURNER, ROGER P., Jun., Care, P.R.A., P.O. Box 1628, Baton Rouge, La., resigned Dec. 10, 1948.

WAGNER, FRANCIS VINCENT, Assoc. M., Structures Engr., North American Aviation Inc., Municipal Airport, Los Angeles (Res., 566 Las Casas Ave., Pacific Palisades), Calif., resigned Dec. 18, 1948.

WILLIAMS, ALEXANDER HUTCHESON, Jun., Prin. Engr. Aide, State Dept. of Highways (Res., 1806 South Blvd.), Richmond, Va., resigned Dec. 20, 1948.

WITTEN, LOUIS, Jun., 2nd Lt., Air Corps, U.S.A., 6 No. Collington Ave., Baltimore, Md., resigned Dec. 22, 1948.

Glossary of Water Use Approaches Completion

SELDOM DOES A technical production receive the long and intensive attention that has been accorded the new ASCE publication entitled *Glossary: Water and Sewage Control Engineering*. Actual work on the compilation goes back some 13 years, and several groups have been active on it, sometimes concurrently. Collaborating organizations were the Society, the American Water Works Association, the Federation of Sewage Works Associations, and the American Public Health Association. Revised definitions were studied and approved in detail. Where improvements and further revisions were indicated, the combined reference committee conferred together and passed on the amended form.

Now the publication is in its final stages, with the material in type and last corrections being made. It is expected that shortly the type will be released to press for distribution on behalf of the four organizations.

The Society has been active on the committee work and has donated a great deal of editorial staff effort. It will also handle the mail distribution. In accordance with recent instructions from the Board of Direction, a charge for the glossary will be required to cover costs.

Final announcement of mailing schedules and prices will be made soon.

"Civil Engineering" Index for 1948 Is Available

MATERIAL APPEARING IN the twelve issues of CIVIL ENGINEERING from January through December 1948, is included in the index to Volume 18, now available without charge on request to Society Headquarters for those desirous of incorporating it in their 1948 bound volumes. For convenience, an order blank is given on page 95 of the advertising department.

Single copies of the index are sent to all subscribing libraries. Extra copies are available on request.

Scheduled Events

Arizona—Winter meeting at Yuma on March 5. Business and technical sessions in the morning followed by luncheon and an inspection trip to Morelos Diversion Dam on the Colorado River at Algodones, Mexico, are planned.

Central Ohio—Dinner meeting at the Chittenden Hotel, Columbus, February 17, at 6:15 p.m.

Cleveland—Meeting at the Cleveland Engineering Society, Cleveland, February 18; dinner at 6:30 p.m. and meeting at 7:30 p.m.

Colorado—Meeting in the Festival Room of the Oxford Hotel, Denver, February 14; dinner at 6:30 and meeting at 7:30 p.m.

Los Angeles—General dinner meeting to be held at the Alexandria Hotel, Los Angeles, February 9, at 6:30 p.m. Meeting of the Junior Forum, Alexandria Hotel, Los Angeles, February 9, at 5:30 p.m. The Sanitary Group of the Los Angeles Section will meet at the Hotel Clark, Los Angeles, on February 23, at 6 p.m.

Maryland—Meeting in the Engineers' Club of Baltimore, February 16, at 8 p.m. Preceded by cocktails at 6 p.m. and dinner at 7 p.m.

Metropolitan—Meetings of the Junior Branch, to be held in the Engineering Societies Building, New York City, at 7:30 p.m., follow: February

9, Gordon F. Whitney of Barber Greene, will give an illustrated talk on highways in the United States; and February 23, C. Lauber, with the National Board of Fire Underwriters, will speak on "Engineers in Fire Underwriting."

Philadelphia—Meeting at the Philadelphia Engineers' Club on February 8, at 7:30 p.m.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Temple, Sacramento, 12:30 p.m.

San Francisco—Meeting at the Engineers' Club of San Francisco, February 15. Weekly luncheons are held on Wednesday in the Club.

Virginia—Annual meeting at the Jefferson Hotel, Richmond, during the afternoon and evening of February 11.

Wisconsin—Meeting in the ESM Building, Milwaukee, February 24; dinner at 6:30 and meeting at 7:30 p.m.

Scheduled ASCE Meetings

SPRING MEETING
Oklahoma City, Okla., April 20–23
(Board of Direction meets April 18–19)

ANNUAL CONVENTION
Mexico City, Mexico, July 12–14
(Board of Direction meets July 10–11)

FALL MEETING
Washington, D.C., November 2–4
(Board of Direction meets October 31–November 1)

Recent Activities

CINCINNATI

VARIOUS PHASES of construction costs were discussed by a panel of Cincinnati engineers at a recent meeting. H. D. Loring, vice-president of the Ferro Concrete Construction Co., launched the discussion with a study of general cost aspects of the construction industry, analyzing the "productive effort" of the individual worker. He was followed by Vernon Hecht, secretary-treasurer of the Meyer-Hecht Co., who discussed the effect on construction costs of properly prepared plans and specifications and the utilization of adequate modern mechanized equipment on jobs. In summarizing the subject, W. V. Schmiedeke, chief engineer of Penker Associates, Inc., brought out the additional point that construction costs and the productive effort of the individual worker are seriously affected by inferior materials and poor delivery of materials, prevailing conditions in the construction industry today.

COLORADO

THE 40TH ANNIVERSARY of the founding of the Section was observed at the recent annual meeting and Ladies Night. ASCE Past-President and Honorary Member Herbert S. Crocker, the only charter member present, described the organization of the Section in December 1908 by 20 charter members and congratulated it on its growth to a present membership of more than 400. During the evening certificates of life membership were presented to William H. Nalder, Foster Towle, and John R. Iakisch. New Section officers, announced during the meeting, are Carl A. Gould, president; John S. Marshall, vice-president; and August L. Ahlf, secretary-treasurer. To mark the Section's anniversary, the newly elected president has sent a circular letter to all ASCE members in Colorado, describing the growth of the Section and urging affiliation in the Section and participation in Society and Section affairs.

CONNECTICUT

ENGINEERS FROM THE Connecticut State Highway Department—Edward J. Gray, Karl T. Dworak, and Dana H. Lyons—described construction operations and showed moving pictures of the building of the Raymond E. Baldwin Bridge over the Connecticut River at a recent dinner meeting. An open forum on the construction of the bridge, which was opened to traffic early in December, concluded the program. Senior civil engineering students from Yale University were guests of the Section.

FLORIDA

AT THE SECTION'S annual meeting a certificate of life membership was presented to Brig. Gen. Gilbert A. Youngberg. Recipients in absentia were Lt. Col. Leander Larson and Lt. Col. Edward N. Chisolm. In the annual election of officers, Walter J. Parks, Jr., was chosen president, and Edward Broadhurst, secretary-treasurer. The speakers of the evening were Leonard Mosby, a student in the speech department at the University of Florida, and William Watson, senior civil engineering student at the university.

INTERMOUNTAIN

RECOMMENDATIONS THAT THE Utah Registration Law be amended to incorporate engineers in training in the definition of an engineer were made in an open forum on registration that comprised the technical program at a recent meeting. A motion was made and seconded that a committee be appointed to visit the new governor and urge the appointment of engineers to state posts that should be filled by engineers. During the evening Merrill Hanson, of the Utah State Department of Publicity and Industrial Development, showed films depicting the scenic wonders and recreational possibilities of the state. At another recent meeting, C. O. Roskelly spoke on "Utah's Position with the Upper States on the Colorado River." Section officers for 1949 are: Milton T. Wilson, president; George P. South, first vice-president; Cleve H. Milligan, second vice-president; and C. E. Painter, secretary-treasurer.

KANSAS

RESULTS AND RECOMMENDATIONS of the Kansas Highway Fact Finding Committee were reviewed at a recent meeting by Paul G. Martin, planning engineer for the Kansas State Highway Commission. Problems involved in the planning, design, and construction of the proposed U.S. Route 54 through Wichita were discussed at a joint dinner meeting of the Section and the Wichita Society of Professional Engineers. Participating in the program were Ward Hartley, of the Wichita Engineering Department; L. K. White, city engineer of Wichita; D. L. Lacey, field soils engineer for the Kansas Highway Commission; and Ralph O. Smith, resident engineer for the Commission.

KANSAS CITY

ENGINEERING CONDITIONS IN Europe were described at the Section's annual meeting by former ASCE Vice-President Ernest E. Howard, who represented the Society at the International Conference of Bridge and Structural Engineers at Liege, Belgium, while abroad. Mr. Howard commented particularly on the repair of roads and bridges, stating that it has been unusually rapid and effective, considering the difficulties under which engineers work. Stephen E. Shoup, recipient of a certificate of life membership, also spoke briefly. During the business session, the following officers were elected for 1949; Josef Sorkin, president; Mark C. Culbreath, first vice-president; William L. Patterson, second vice-president; and J. Q. A. Greene, secretary-treasurer.

MARYLAND

IN A REVIEW of recent activities of the Board of Direction, presented at the Section's annual meeting, ASCE President R. E. Dougherty analyzed some of the problems facing the Society and commented on the reduced budget necessitated by defeat of the dues increase amendment. Mr. Dougherty also spoke of the Society's need for EJC to keep abreast of developments in legislation in the next Congress which may affect the

profession. EJC was discussed on the local level by Paul Holland, who reported recent activities of the Maryland joint council. Life membership certificates were presented to Gustav J. Requardt and F. G. Wrightson, Jr., and to O. B. Bestor in absentia. New officers, unanimously elected during the business session, are Gurney H. Dayett, president; Paul G. Crout, vice-president; and William R. Kahl, secretary-treasurer.

METROPOLITAN

IN A TALK entitled "Foundations Come First," presented at a recent meeting of the Junior Branch of the Section, Hal W. Hunt, executive engineer of the Western Foundation Co., New York, N.Y., discussed important pile and foundation problems. There was an attendance of about 60.

MIAMI

THE POSSIBILITY OF having study and discussion groups within the Section was reviewed at the January 7 meeting by a committee that has been canvassing the situation. The committee stated that there is considerable demand among Juniors for refresher courses for state examinations, and arrangements for providing such courses will be considered. A talk on the present economic situation, given by Grover A. J. Noetzel, dean of business administration at the University of Miami, comprised the technical program. Roy H. Wilson, of West Palm Beach, received a certificate of life membership from Section Past-President Edmund Friedman.

MID-MISSOURI

ASCE DIRECTOR Webster L. Benham attended a joint meeting of the Section and the University of Missouri Student Chapter, at Columbia, and spoke on current Society activities and problems. The remainder of the program was furnished by student speakers—Robert Ketter, John Bernhardt, John Wright, and Gerald Gillian. Albert Kensley, president of the Student Chapter, presided.

MID-SOUTH

WAYS OF INCREASING the prestige of the engineer in the eyes of the public and of raising the status of the whole profession were graphically presented to the Mid-South Section at its recent three-day annual meeting, held in Little Rock, Ark., in a penetrating report of its Committee on Professional Objectives. The committee preparing the report, which was widely acclaimed, was headed by Charles Senour. Other highlights of the annual business meeting included a talk on Society affairs by ASCE Director Webster L. Benham and election of officers for 1949, which resulted in the selection of Warner R. Spencer for president; Willard J. Turnbull, vice-president; and Francis E. Mitchell, secretary-treasurer. A talk by Mrs. S. Ladd Davies, wife of a Section member and former officer in the Army Sanitary Corps, on the mode of life and native customs in Peru, was enthusiastically received at the annual dinner meeting. Presentation of a certificate of life membership to James Rush Rhyne featured the annual luncheon. Speakers on the Friday technical program included Harrison H. Roberts, chief engineer for Ozark Dam Constructors, builders of Bull Shoals Dam, which Mr. Roberts discussed; Bill Andrews, head of the Urban Planning Section of the Public Roads Administration at Fort Worth, Tex., whose subject was "Some Concepts and Standards of Urban Highway Improvements"; and Roy P. Hart, chief engineer of the Missouri Pacific Railroad, who described grade and line revision on primary lines. A whole day was devoted to inspection of aluminum plants in the Little Rock area. Starting with the open-pit mining of bauxite, the group followed the process of obtaining alumina at the Hurricane Creek Aluminum Plant and finally, at the Jones Mills Aluminum Reduction Plant, witnessed the reduction of the alumina to pure aluminum.

MONTANA

THE POSSIBLE FORMATION of branches within the Montana Section to accommodate ASCE members in isolated areas of the Section was discussed at a recent meeting at Great Falls, Mont. Participants included Society Director W. L. Malony, of Spokane, Wash., who stated that the Society is against the formation of new Sections at present because of the financial situation, but that no restrictions will be placed on the organization of branches. A resolution advocating formation of branches in localities "where the membership warrants and desires such action" was passed at the conclusion of the discussion. Speakers on the technical program were Scott P. Hart, state highway engineer, who described the general organization of the highway department; L. H. Richter, who discussed air-entrained concrete; and Claud A. Martin, who outlined present plans for the proposed Missouri River crossing at Great Falls. New Section officers are John H. Morrison, president; John D. Officer, first vice-president; Harold O. Egeberg, second vice-president; and Louis Henke, Jr., secretary-treasurer.

NASHVILLE

MOVING PICTURES, showing the construction of expressways and soil cement road construction, were presented at a recent meeting by Oscar Martin, of the Portland Cement Association. Officers for 1949, elected during the meeting, are Wilbur Sensing, president; Alex C. Kelley, vice-president; and Thomas B. Lee, secretary-treasurer.

NEW MEXICO

IN A TALK on "The Upper Colorado River Compact," which featured the annual dinner meeting, Fred Wilson, New Mexico commissioner of the Upper Colorado River Compact Commission, reviewed the history of the compact and stressed its importance. He stated that New Mexico's share of the water passing Lees Ferry was set at 11.25 percent depletion of the flow, which in an average year would give the state more than 800,000 acre-ft of water, sufficient for irrigating approximately 400,000 acres of land. Mr Wilson also called attention to the fact that before the state can make use of this water, projects must be planned and authorized. Engineers in particular, he said, should push these projects. In the open forum following his talk, R. T. Lingle, superintendent of the Vermejo Irrigation District, also stressed the importance of reclamation projects to the state. New Section officers are: R. Elton Cook, president; C. S. Conover, first vice-president; Fred Adams, second vice-president; and Jack E. Counts, secretary-treasurer.

PHILADELPHIA

VARIOUS ASPECTS of the Pennsylvania Turnpike extension to Philadelphia were covered in a symposium comprising the technical program for the January 11 meeting. The entire turnpike project was reviewed by Gerard B. Gilbert, who has been on the Turnpike Commission since 1938 and is also coordinating engineer of the Legal Bureau on extension of the road to Philadelphia. Following his talk, detailed plans for the work were presented by E. J. Kenney, of the Pennsylvania State Highway Department; Charles Howland, chief of the Projects Division of the Philadelphia City Planning Commission; and Charles Elcock, a representative of the Technical Societies' Council, which is working cooperatively with the City Planning Commission on the Philadelphia extension.

ROCHESTER

THERE IS A DEFINITE trend toward liberalization of engineering curricula, John F. McManus, assistant to the dean of engineering at Cornell University, told members of the Section at a recent meeting. Speaking on education in its relationship to the profession, Mr. McManus stated that, though technical and liberal courses are supposed to be in conflict, they actually supplement each other in the well-rounded curricula. There is a growing realization of the fact that the student

Engineering Facts about
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JOHNS-MANVILLE JM PRODUCTS

must be trained not only for success in his chosen profession, but also for intelligent participation in a rapidly changing world—hence the trend away from strict technical specialization as compared with the curricula of a generation ago, according to Mr. McManus. In conclusion, he indicated several ways in which engineering groups can cooperate with educators. These include working through high schools to prepare prospective engineering students for their technical training in college, and promoting cooperative programs between engineering colleges and industry.

SAN DIEGO

ENGINEERING PHASES of soil conservation were discussed at a recent meeting by R. H. Wilkens, district engineer for the U.S. Soil Conservation Service in the San Diego County area. Mr. Wilkens outlined the development of the science of soil conservation and showed, with films, the work that is being done in the West to eliminate erosion by means of contour farming, check dams, and trench ditches. Mr. Wilkens was assisted in showing films by Glen E. Paxton, also of the Soil Conservation Service. At the annual meeting of the Section the following officers for 1949 were elected: R. S. Holmgren, president; J. F. Jorgensen, vice-president; and E. A. Lawrence, secretary-treasurer.

SAN FRANCISCO

A PANEL OF Section speakers—I. C. Steele, O. W. Peterson, and H. W. Haberkorn—addressed the Section's annual meeting on the subject, "America's Biggest Power-Building Program." The symposium covered the postwar construction program of the Pacific Gas and Electric Co., with which all three speakers are connected. The results of balloting for new Section officers, announced during the meeting, are as follows: A. W. Earl, president; C. T. Wiskocil, junior vice-president; and R. D. Dewell, secretary-treasurer. G. B. Woodruff continues in office as senior vice-president.

SEATTLE

REASONS WHY A broad education is necessary for the young engineer were emphasized in a talk on modern trends in engineering education, given at a recent meeting by Harold E. Wessman, dean of the college of engineering at the University of Washington. Reviewing the history of the past few decades in engineering education, Dean Wessman showed that the present trend toward liberalizing engineering curricula is not completely new. His recommendations include a four-year undergraduate course with postgraduate work for those fitted. Many schools, he pointed out, have revised their curricula to include more humanistic studies in the belief that such training will better fit the engineer to take his proper place in society. During the meeting, a certificate of life membership was presented to E. B. Crane, who gave a brief speech of acceptance. The Section's new officers are: E. L. Strandberg, president; George I. Teufel, vice-president; R. O. Sylvester, secretary; and James H. Reid, treasurer.

SPOKANE

THE ARMY ENGINEERS' plan for development of the Columbia Basin was detailed by Col. William Whipple, district engineer for the Corps of Engineers at Walla Walla, at a recent meeting of the newly organized Columbia Branch of the Spokane Section (originally termed the Richland Branch). The main control plan, with which all integral parts and sub-basin plans are to be correlated, Colonel Whipple said, starts with a series of dams to provide slack-water navigation as far as Lewiston, Idaho. These same dams, he pointed out, along with others reaching into Montana, will provide the greater part of the power needed and serve for flood control as well. Only minor revisions to existing dams, including Bonneville and Grand Coulee, will be necessary to fit them into the complete project.

St. Louis Section Is Host to Student Chapters

AT THE ANNUAL BANQUET MEETING the principal speaker was Harry M. Fite, director of organization and management for the Economic Cooperation Administration, Washington, D.C. Mr. Fite explained how his agency set up the organization for the Marshall Plan, and analyzed many of the problems involved in the economic rehabilitation of Western Europe. The attendance of 248 included 85 students from the University of Missouri, the Missouri School of Mines, and Washington University. A gain of 55 new members during the year, including 35 Juniors, was announced, and Col. Lawrence B. Feagin, chairman of the Membership Committee, was commended for his excellent work, especially among the younger engineers. In a talk entitled "Air-Borne Prospecting," presented at a joint meeting with the Engineers' Club of St. Louis and the local chapter of the AIMME, E. L. Clark, geologist for the Missouri Geological Survey, explained how the airborne magnetometer was developed as an outcome of wartime inventions in the field of submarine detection. The device has proved useful in geophysical prospecting for mineral deposits, Dr. Clark pointed out.

SEATED AT SPEAKER'S TABLE at annual banquet of St. Louis Section are, left to right, Col. Malcolm Elliott, vice-president of Section; Ernest W. Carlton, professor of civil engineering at Missouri School of Mines; Walter R. Crecelius, incoming president of Section; Harry M. Fite, speaker of evening; William J. Hedley, retiring Section president; John I. Parcel, past-president of Section; E. O. Sweetser, professor of civil engineering at Washington University; Secretary-Treasurer Henry S. Miller; Robert B. B. Moorman, professor of civil engineering at University of Missouri.

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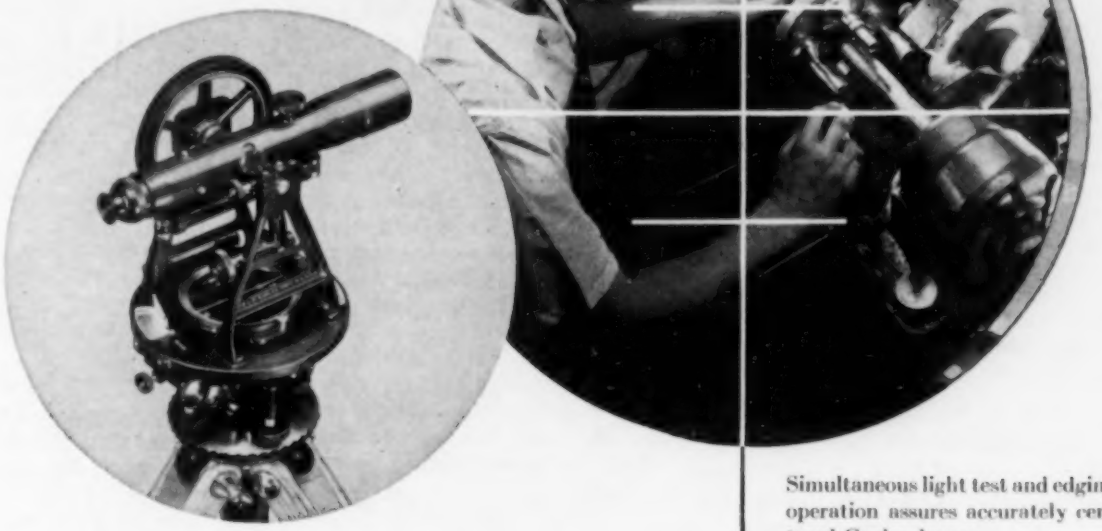

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SOUTHERN IDAHO

WAYS OF ELIMINATING the smoke problem in Boise were discussed at a recent meeting by Robert Hoque, of the Idaho Power Co., and member of the Smoke Abatement Committee for the City of Boise. The city has already taken measures to get rid of excess smoke, Mr. Hoque declared, and he described ways in which engineers can assist in the effort to improve conditions. Showing of a colored film on the Craters of the Moon National Park in Idaho completed the program.

TACOMA

DESIGN AND CONSTRUCTION features involved in reconstruction of the Tacoma Narrows Bridge were discussed by Charles E. Andrew, consulting engineer for the Washington Toll Bridge Authority, at a recent dinner meeting. Mr. Andrew commented, particularly, on aerodynamic considerations incorporated in the design. Continuing a policy of encouraging its younger members to take part in Society activities, the Section presented a panel of Junior speakers—George H. Andrews, Margie Jean Thornberry, and F. R. Worthen—in ten-minute talks.

TEXAS

CONGRESSMAN WINGATE LUCAS, who recently returned from a trip to Europe, where he was a guest of Gen. Lucius Clay, addressed the December meeting of the Fort Worth Branch. In commenting on the general European situation, Mr. Lucas stated that the Berlin Airlift is of tremendous value in improving the morale of our own men in the occupation forces and that of the people of western Germany and in gaining prestige for the United States. Since 5,000 tons of goods are delivered each day by the airlift, our military force in Europe is gaining valuable experience in the moving of large quantities of goods by air, Mr. Lucas pointed out.

TRI-CITY

QUALITY CONCRETE AND the tilt-up method of constructing concrete buildings were discussed by Marts D. Blue, district structural engineer for the Portland Cement Association, at a recent Section meeting at Davenport, Iowa. During the business session, a resolution was passed honoring Life Member H. P. Warren, who is retiring as chief of the Operations Division of the Rock Island District of the Corp of Engineers. C. M. Stanley, Muscatine consultant and president-elect of the Iowa Engineering Society, was the principal speaker at a joint meeting with the Iowa Engineering Society and local groups of the ASME and AIEE, held at Rock Island, Ill. Mr. Stanley outlined a plan for the organization of local engineers clubs that is being promoted by the Iowa Engineering Society. New Section officers are A. F. Burleigh, presidents; F. H. Beinhauer, vice-president; and R. G. Stearns, secretary-treasurer.

TOLEDO

SPECIFICATIONS WERE DEFINED as the range within which work may be done, in a talk given at a recent meeting by Herbert F. Kriege, technical director of the France Stone Co. A statement that nations have specifications for war but none for peace led to a discussion of world affairs. At the Section's annual meeting, the following new officers were elected: Charles R. Strattman, president; Clair A. Shaler, second vice-president; and Charles H. Kurtz, Jr., secretary-treasurer. C. L. Pettis was advanced to the office of first vice-president. The technical program consisted of a talk on "The Blast Furnace and the Manufacture of Pig Iron," by John H. McDaniel, general superintendent of the Toledo plant of the Interlake Iron Corp.

WEST VIRGINIA

LOGISTICS AND ENGINEERING problems involved in the invasion and recapture of the Philippines were described at a recent meeting by Col. A. M. Neilson, district engineer for the Army Corps of Engineers. Colonel Neilson spoke from first-hand experience, having been active in the entire campaign. During the evening, certificates of life membership were presented to William Brewster and Arthur V. Spinosa. A third recipient, R. P. Davis, was unable to attend.

WISCONSIN

IN A PAPER on "Soils as a Pavement Foundation," presented at a recent meeting, A. T. Bleck outlined current practices of the Wisconsin Highway Commission, of which he is chief construction engineer. At the conclusion of his talk, Mr. Bleck answered numerous questions on foundation problems, involved in both highway design and building construction.

STUDENT CHAPTER *Notes*

COOPER UNION

MORE THAN 200 engineering students at Cooper Union heard R. E. Dougherty, ASCE President, address a recent joint meeting of the Student Chapter and the ASME Chapter on the campus. President Dougherty, for many years vice-president in charge of improvements and developments of the New York Central Railroad, presented some of the problems that are being encountered in modern railroading and the methods of achieving solutions. In concluding, President Dougherty advised the aspiring engineers to "look at your professions in the broadest possible manner. Don't look only at technical aspects."

CITY COLLEGE OF NEW YORK

THE PROFESSIONAL NEEDS of the civil engineer were discussed before a recent meeting of the Dam Club, a group of City College graduate engineers, by Charles B. Molineaux, chief engineer of the Arthur Johnson Corp., Long Island City, N.Y., Mr. Molineaux based his facts on the replies received from professional engineers—in the teaching field and in private practice—in a survey to determine their opinions on what is needed to make a professional engineer. Prof. William Allan, dean of the City College School of Technology, and several members of the civil engineering department attended the Dam Club meeting as guests. The president of the group is Joel Wiesenfeld, assistant professor of civil engineering at Rutgers University. William Armento was chairman of the committee on arrangements for the meeting.

JOHNS HOPKINS UNIVERSITY

RECENTLY 40 MEMBERS of the Johns Hopkins Student Chapter toured the Baltimore plant of the National Gypsum Co., which is one of the most modern plants of its type in the world. An illustrated talk on the proposed expressway system for Boston, Mass., was presented by Joseph K. Knoerle, of J. E. Greiner Co., at a recent meeting. Dean J. Wilson Schaffer, College of Arts and Sciences at the university elaborated on the subject, "Psychology of Humor," the first of a series of discussions designed to give the engineer student a better understanding of the cultural studies.

On April 9 the Chapter will be host to the Maryland-District of Columbia Regional Student Chapter Spring Conference. Participating are the Catholic University, University of Maryland, George Washington University, and Johns Hopkins University. A technical session, to be presided over by C. W. Gregory, president of the Johns Hopkins Student Chapter, is planned for the morning, an inspection trip to the Glenn L. Martin Co. and the Bethlehem Steel Co. for the afternoon, and a banquet in the evening.

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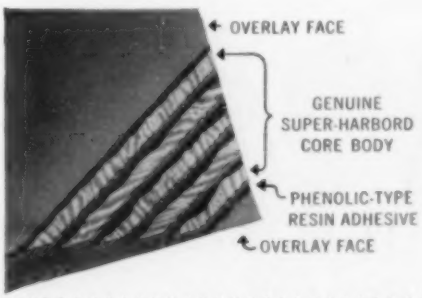

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ILLINOIS INSTITUTE OF TECHNOLOGY

IMPRESSING THE STUDENT engineer with the ethics, problems, and responsibilities of the professional engineer, has been the objective of recent meetings of the Illinois Institute of Technology Student Chapter. In furthering this program Prof. F. W. Edwards, newly appointed chairman of the civil engineering department at the Institute, discussed the versatility required on a major engineering project and the need for broader training in engineering. The more abstract phases of the professional engineer's career—the need for a job well done with full explanatory reports—was stressed by Virgil E. Gunlock, commissioner of subways and highways for the City of Chicago, Ill. The membership of the Chapter has increased to 168 students.

SOUTH DAKOTA STATE COLLEGE

TO GATHER first-hand information on dam construction, the Student Chapter of the South Dakota State College made a recent inspection trip to the Fort Randal damsite, a U. S. Army Engineer project under construction on the Missouri River near Pickstown, S. Dak. Charles Brown, chief of construction on the project, outlined the plan, with the aid of maps and a model, and also indicated the progress achieved so far. Inspection of the soils laboratory, with Leonard Strutz, director of the laboratory, acting as guide, concluded the trip.

UNIVERSITY OF NORTH DAKOTA

VARIOUS ASPECTS of city management were discussed by Byron Rockwood, city manager of Grand Forks, N.Dak., at a recent meeting of the University of North Dakota Student Chapter. A banquet meeting—sponsored by the Chapter and held jointly with the North Dakota State Student Chapter—featured a talk by William B. Irwin, assistant engineer, Great Northern Railroad Co., on the development of the Alaskan Railroad. E. L. Lium, head of the civil engineering department at the university, acted as toastmaster, and local members of the Great Northern engineering staff attended as guests. The officers of the Chapter for this school year are Duane Schue, president; Ralph Mohagen, vice-president; James Mickle, treasurer; Norman Fassett, secretary; Royal McKay, historian. Prof. I. R. Jensen is faculty adviser of the Chapter, which now has a total membership of 73.

MEMBERS OF UNIVERSITY OF NEW MEXICO STUDENT CHAPTER are pictured on university campus in Albuquerque. Large bulletin board, in center, is normally displayed in engineering building, where it calls attention to salient Student Chapter activities and serves as reminder of Chapter meetings.

UNIVERSITY OF FLORIDA

THE ADVANTAGES OF belonging to a professional society were detailed by Dean Johnson, of the civil engineering department at the University of Florida, at a recent smoker meeting sponsored by the University of Florida Student Chapter. An attendance of 250 attested to the success of the meeting.

STUDENT CHAPTER PRIZE CONTEST

PRIZES FOR THE eleventh annual Student Chapter convention—sponsored jointly by the Philadelphia and Lehigh Valley Sections and scheduled to take place at the University of Pennsylvania, on April 25—have been announced. The contest is limited to senior and junior civil engineering students and one paper from each Student Chapter. Prizes of $30, $20, and $10 will be given to the three outstanding papers. Papers are to be submitted to the judges by March 25. For details, members should consult their Chapter adviser.

NEWLY REACTIVATED STUDENT CHAPTER at University of Dayton, with membership of 30, is photographed on university campus. Prof. George J. Spahn is faculty adviser for group. Harry Gaeke is president of Chapter, and Charles Dorian secretary-treasurer.

Welded Steel Framework Cuts Cost 50%

By Francis J. Schroedel, President
Schroedel Construction Company, Milwaukee, Wisconsin

DIRECT savings of 50% over masonry and fire resistive construction are being realized in the erection of four 12-family apartment units, eight 16-family units and one 24-family apartment for the Estabrook project in Shorewood, Wisconsin. These savings result from greatly simplified construction methods using steel members for wall frame and floor joists and are made possible by arc welding.

A modular design using 2-foot increments enables mass production arc welding techniques for fast, low-cost shop fabrication of wall panel members for the first and second floors. Bethlehem open-web expanded-steel studs are welded between a channel cap or girt and a sill plate for both the first and second floor panels. Three-quarter inch channel is added between the studs for horizontal bracing.

During field erection, the wall panels are raised into position, held in place with a simple clamp (Fig. 1) and arc welded with 5/32" diameter "Fleetweld 5" electrode, using 200-amp. engine-driven Lincoln "Shield-Arc" welders. The first floor framing is welded into an integral unit, and a finished concrete floor is later poured to cover the sill plates thus anchoring the building frame in position.

An "I" beam, supported by two outside walls and the center utility room walls, forms the center support for the expanded steel second floor framework. The erection of the second floor panels is then done without the need for any scaffolding.

Exterior walls are finished with masonry, and interior plastering is applied to metal lath. In addition to direct cost savings in the building erection, additional benefits are easier, less costly installation of plumbing, wiring and insulation. The structure is both shrinkproof and verminproof.

Fig. 1. Arc welding steel panels to form the side walls. Panels are made from 4" Bethlehem expanded steel studs.

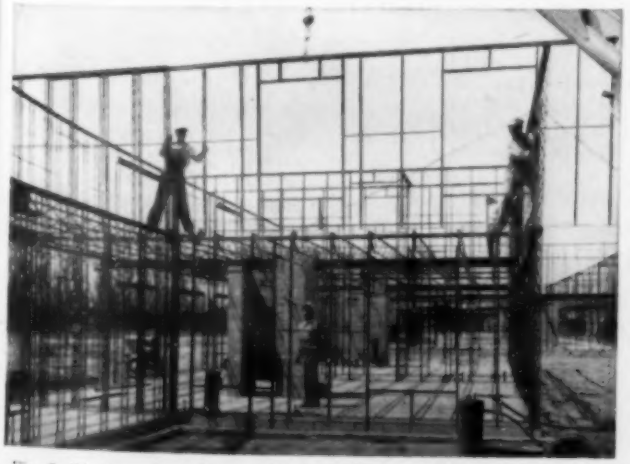

Fig. 2. Placing second floor prefabricated steel wall panels in position. Panels are hoisted and welded in place without use of any scaffolding.

Fig. 3. Framework for one of many multiple family apartments built with all-welded steel construction. The Estabrook Homes project is located in Shorewood, Milwaukee, Wisconsin.

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NEWS BRIEFS

Predicts Public Construction in 1949 Will Reach Record High in Dollar Value

IN TERMS OF dollar value, the assumed total of new construction for 1949 appears to set a new record, surpassing even the war years, J. W. Follin, M. ASCE, assistant administrator of the Federal Works Agency, states in a construction forecast appearing in a recent issue of *Public Construction*, official publication of the FWA.

In terms of physical volume, however, construction for 1949 will probably represent only a slight increase over 1948, according to Mr. Follin. This means a smaller construction volume than was accomplished in 1941 or 1942, or in any of the years from 1924 to 1929. While new construction averaged close to 11 percent of the national income during the 1920–1939 period, this relationship was closer to 8 percent in 1948 and probably will not be higher in 1949.

Divergent trends in public and private construction are among the most significant construction changes anticipated. It is expected that the value of public construction will increase by almost 25 percent over 1948, whereas private construction in the same period may decline moderately.

Basing his conclusions on an FWA continuous, day-by-day analysis of current contract awards in all public jurisdictions, Mr. Follin states that, of an assumed total volume of $18,250,000,000 in 1949, public construction could account for as much as $5,000,000,000. The public portion represents 27 percent of the total, instead of 23 percent as in 1948. It appears that the state and local volume of public construction, with a value of $3,300,000,000, will considerably outweigh federal contruction estimated at $1,700,000,000.

"The increase in public construction may be traced in part to previous postponements," according to Mr. Follin. "During the war years, it was to channel men and materials to essential war construction. Since the end of the war, public construction has generally been postponed to favor the greatest possible volume of housing and other needed types of private construction. The latter have made additional demands for public works facilities. As a result, vast needs for public projects have accumulated. It becomes increasingly difficult to postpone further the most essential of these pressing requirements."

A sharp increase in volume of school and public hospital construction is foreseen for 1949. Sizable increases also are expected in conservation and development, including reclamation projects, river and harbor work, and flood control, and in sewer and water and other types of public construction. Highway construction of all kinds is estimated at $1,750,000,000, an increase of nearly 15 percent over the 1948 volume.

While the estimated dollar value of public construction for 1949 appears to set a new record, Mr. Follin points out that the physical volume, although an increase over 1948, is well below the war years and slightly less than in 1939. This fact is attributed to "the continued deferment of a sizable volume of public projects and the actual construction of only the most needed facilities in spite of the accumulated deficits."

Predicting that it may be possible to step up public construction by almost 25 percent in 1949, Mr. Follin states that lack of materials will no longer be a handicapping factor. The output of almost all building materials increased at a rapid rate during 1948, and a similar increase is expected in 1949. In particular, increased supplies of cement, lumber and metal products are anticipated. Other promising factors listed include the current high level of construction employment, the greater number of active qualified apprentices, plus an increase in labor productivity.

Engineering Firms Exempted from Labor Standards Act

BY A RECENT ruling in the Federal Court of Baltimore, Md., the Fair Labor Standards Act does not apply to professional architects and engineers and their staffs of technically trained employees. This decision was rendered by Judge W. Calvin Chestnut in injunction proceedings filed by the wage-and-hour administrator, William R. McComb, against the Baltimore consulting firm of Turpin, Wachter & Associates, in an attempt to require the firm to pay overtime compensation to its employees and to keep employment records.

One of the major objectives of the Fair Labor Standards Act, which was passed in 1938, was to put a floor under wages and to spread employment by requiring pay for more than a 40-hour week, at time and a half the regular rate, for employees engaged on the production of goods in interstate commerce. Interpretations of these provisions by the administrator of the law and the courts have been so varied that employers have often been at a loss to know whether or not they were violating the law.

In the present case, the administrator contended that the Baltimore firm was engaged in the production of goods in commerce, as defined by the Fair Labor Standards Act, because its plans are mailed or sent to other states. He also argued that the firm was engaged in interstate commerce because it prepares plans for airport paving, for additions and alterations to buildings, and for bridges over waterways already being used in interstate commerce.

Judge Chestnut ruled that the employees of the firm are too remotely concerned with interstate commerce to come under jurisdiction of the Act and that the plans on which they work are prepared for a particular client and are not for public sale.

Philadelphia Advised to Lease Its Water System

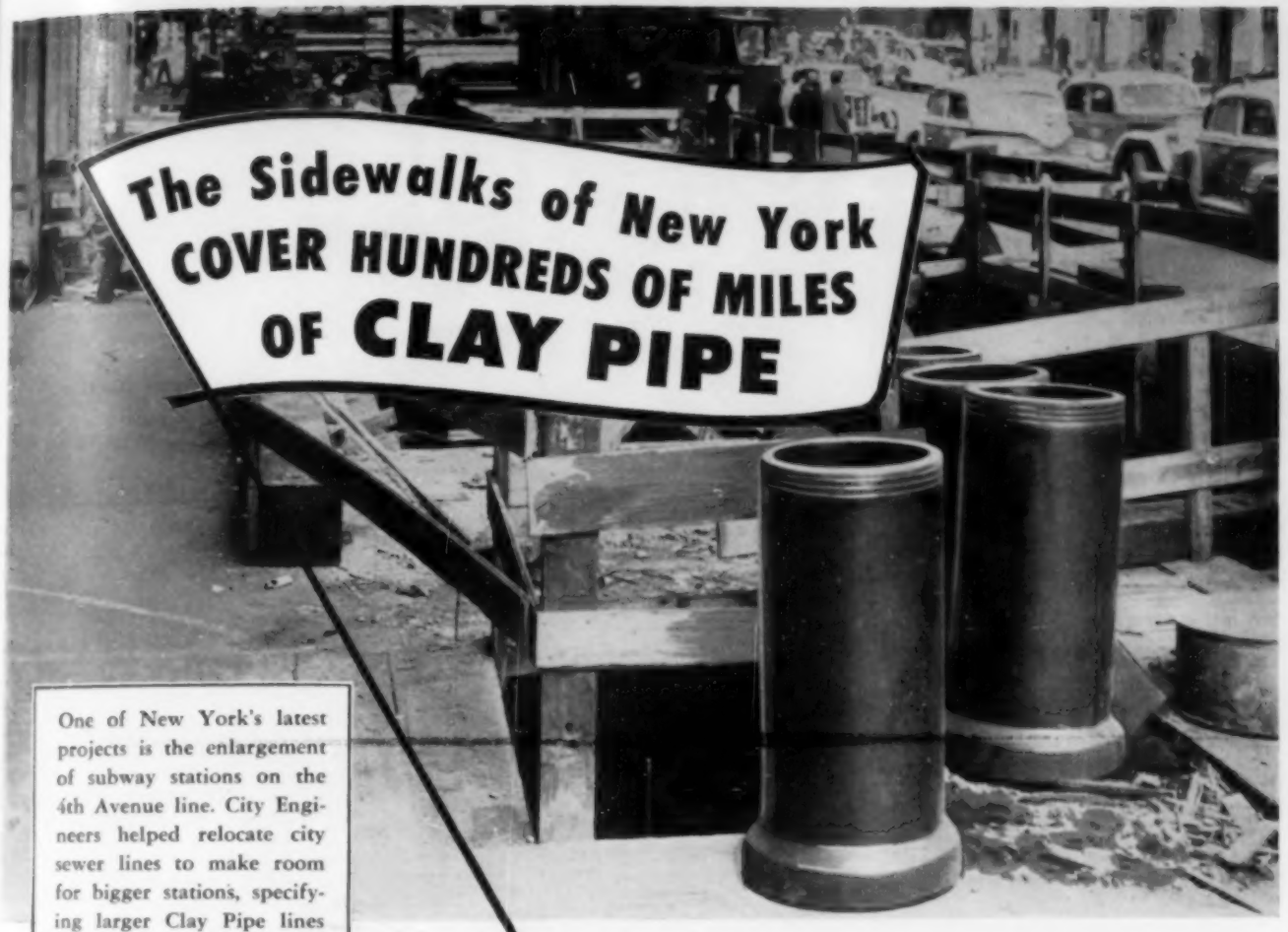
RECOMMENDATIONS THAT THE City of Philadelphia should give up operating its water system were made to the city's Committee of Fifteen as the result of a survey made for the committee by the Philadelphia consulting firm of Charles Haydock, M. ASCE. According to the survey, principal weaknesses in the present method of operation include insufficient maintenance, made acute by wartime shortages of labor and materials; intermingling of water revenues with those of other city agencies; inadequate personnel; and an inadequate meter program.

The city was advised to turn the system over to a private enterprise under lease, an arrangement similar to that under which the city-owned gas works is now operated by the Philadelphia Gas Works Co. Or failing that, it was suggested that the water system be placed under an authority type of management.

Rise in Steel Making Capacity Is Foreseen

WITH STEEL PRODUCTION for the week beginning January 10 setting a new record, 26,300 tons above the previous peak week, the operating rate of steel companies having 94 percent of the industry's capacity was 99.3 percent of capacity, according to a recent release of the American Iron and Steel Institute. This rate is equivalent to 1,830,600 tons of steel ingots and castings, compared with 1,802,500 tons for the previous week; 1,723,200 tons for the same week in 1948, and 1,281,210 tons for the average week in 1940, the highest prewar year.

Present schedules of the industry call for the addition of 2,200,000 tons in 1949 and 500,000 tons in 1950, enabling a total production capacity of more than 98,000,000 tons by the end of 1950. To support this great increase in steel-making capacity, other production facilities are also being expanded and improved. Blast furnace capacity was increased sharply during 1948 and, at the beginning of 1949, was rated at 70,500,000 tons a year.



One of New York's latest projects is the enlargement of subway stations on the 4th Avenue line. City Engineers helped relocate city sewer lines to make room for bigger stations, specifying larger Clay Pipe lines where they were needed. Where the lines were to remain the same size in their new locations, the *original Clay Pipe* was used again.

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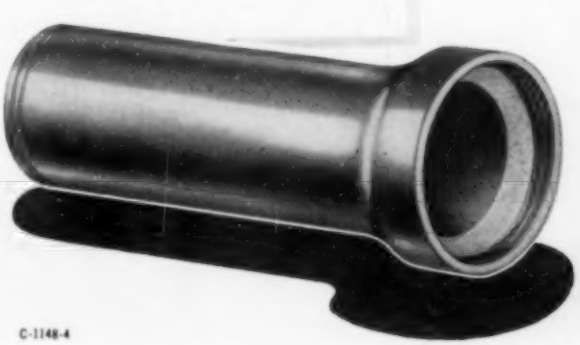

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Virginia Completes $48,750,000 Road Program in 1948

VIRGINIA CONDUCTED A $48,750,000 road construction and maintenance program in 1948, according to a recent release of the State Highway Department. Construction expenditures for both the primary and secondary systems amounted to $32,000,000, with maintenance expenditures totaling $16,750,000.

Included in the 218 miles of new primary road construction were 39 miles of four-lane highway. In addition, 67 new bridges were completed on the primary system during the year.

On the secondary system of farm-to-market and connecting routes, 500 miles were hard-surfaced and 200 new bridges were built. Bituminous retreatments were applied to 1,400 miles, and some 1,600 miles were surfaced with crushed stone and gravel. Virginia is one of four states in the nation charged with the administration of the entire rural road network within its boundaries.

Important projects completed during the year include a three-level railroad-highway interchange on U.S. Routes 13 and 460 near Norfolk; portions of the limited-access Shirley Memorial Highway near Washington; a large four-lane bridge across the Roanoke River and the Virginian Railroad on Route 11 near Salem; major urban construction in the City of Norfolk; and four-lane divided construction on Route 60 east of Richmond.

During the year, 123 new construction contracts were awarded. These call for construction of 212 miles of new road and 53 bridges.

THREE-LEVEL RAILROAD-HIGHWAY INTERCHANGE, constructed near Norfolk by Virginia Department of Highways during 1948, is pictured above. Highway ramp and main line of Norfolk and Western Railway pass on center level. Shown below is construction view of 583-ft four-lane bridge completed during 1948 on Route 11 west of Salem. Bridge crosses both Roanoke River and Virginian Railroad.

Decrease in Highway Accidents Reported

GRATIFYING REDUCTIONS IN traffic fatalities as a result of the Action Program of the President's Conference on Highway Safety are reported by Charles M. Upham, M. ASCE, engineer-director of the American Road Builders' Association, in a recent issue of *Down the Road*, ARBA publication. In 1946, the traffic death rate was approximately 12 for each 100 million miles of travel, and fatalities were costing the country over $2½ billion in property damage, insurance, lost working time, and medical care.

Stating that the Action Program of the President's Conference set out to reduce this ratio from 12 to 6 per 100 million vehicle-miles over a three-year period, Mr. Upham points out that achieving this goal would mean a saving in 1949 of 19,000 lives, 650,000 injuries, and more than $1 billion lost through property damage.

In the first half of 1948, according to Mr. Upham, "we had the lowest traffic death rate in our history computed on the basis of mileage. Although 13,690 persons lost their lives during the six-month period, the death rate by the end of May had declined to 7.2. Estimates for the last half of the year place the figure at below 7.0."

Despite this encouraging reduction in traffic accidents and fatalities, Mr. Upham says it must be noted that the rate of reduction has not been uniform. While some of the states have lowered their death rate considerably below the national average, others are still far above it. Significantly, the states and communities that have faithfully followed the Action Program have the fewest accidents.

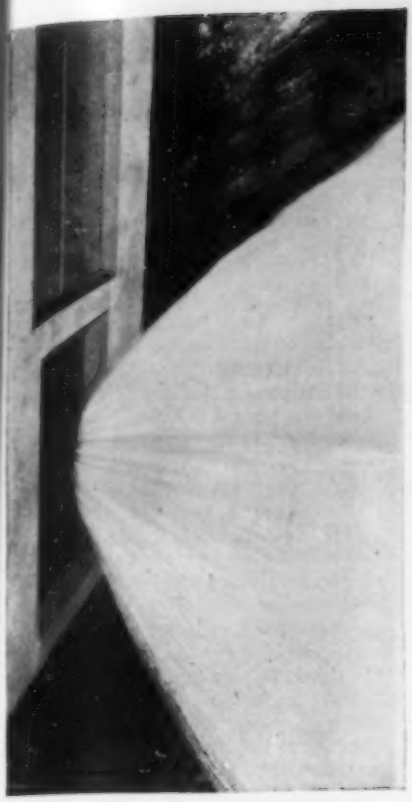
Stressing engineering aspects of the safety program, Mr. Upham states that engineering is perhaps the most important of the "three factors that can prevent highway accidents—education, enforcement, and engineering—because it tends to make the highway foolproof. Education must be repeated year after year and with each new generation of drivers. Enforcement must never be abated. But when a hazard has been eliminated by safe design and construction, it is gone for good. Sound safety engineering makes it difficult to have accidents.

"Traffic accidents have been studied exhaustively by many agencies. There is no longer guesswork about it. We know the type of accident that happens most frequently and what causes it. For each type there is a practical remedy."

Head-on collisions, cited as among the more serious types of highway accidents, can be prevented, Mr. Upham points out, by separating the traffic streams by a center strip. The broader this median strip the better, since it also helps eliminate the headlight hazard at night. Collisions at intersections can be prevented by grade separations, which also prevent railroad grade-crossing accidents.

To keep drivers from running off the road, longer sight distances and easier curves are recommended. Broad, firm shoulders, wide pavements, and guard rails contribute materially to keeping cars on the road and out of danger. The risk of confusing drivers by unclear traffic signs and signals should also be avoided.

Pointing out that almost half of the country's population over 16 years of age is driving automobiles and that car registration for 1948 will exceed 40½ million motor vehicles, Mr. Upham concludes that this mounting volume of highway travel emphasizes as never before the need for proper highway engineering. "All our highways cannot be brought to high technical standards over night. It will take years and cost billions. But the effort and the expenditure are worth it in human life alone."



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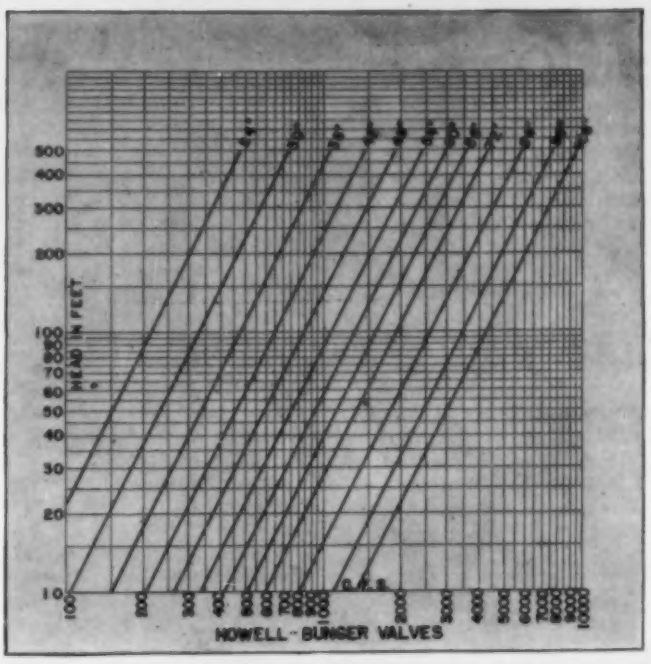

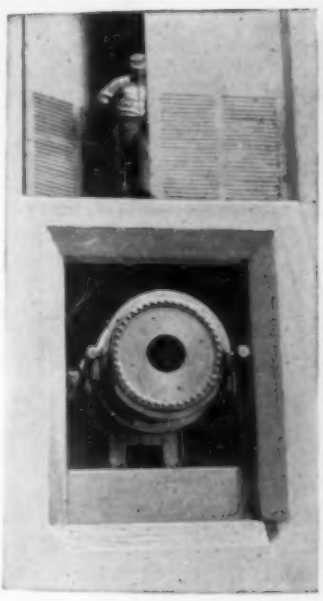

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Hearing Held on Proposed Narrows Suspension Span

ARGUMENTS FOR AND against erection of the proposed $78,000,000 suspension span across the Narrows between Brooklyn and Staten Island were presented at a recent public hearing before the Joint Army-Navy-Air Force Board on the Triborough Bridge and Tunnel Authority's application to build a bridge at that site.

Proponents—including Robert Moses, chairman of the Authority, and O. H. Ammann, M. ASCE, consulting engineer on the proposed structure—urged construction of the span on the ground that it would provide the missing link in the metropolitan area's arterial highway system, would alleviate traffic congestion in Manhattan, and ease the New Jersey traffic load to Philadelphia and Washington. Stating that he favored construction of a suspension span for security reasons, Mr. Ammann added, "Against air attacks or sabotage in time of war the suspension bridge is the least vulnerable type. It would probably require detonation of an atomic bomb in close proximity to the bridge to cause its destruction."

Tentative plans for the structure, which would be the longest suspension bridge in existence, call for a span of 4,620 ft, with towers 705 ft high and vertical clearance varying from 180 ft at the towers to 237 ft at the center. The *Queen Mary*, the tallest ship in the world, would have a clearance of 22 ft above the masts. The indicated location of the proposed span is just north of the government reservations at Fort Hamilton, Brooklyn, and Fort Wadsworth, Staten Island.

Opponents of the structure contended that it would ruin Brooklyn residential areas.

Drought Records Broken in California in 1947–48

THE SUCCESSIVE DRY years of 1947 and 1948 established a new drought record in Southern California, with a combined two-year total to date of 9.63 in. of rainfall, or 31.5 percent of normal, according to C. C. Elder, M. ASCE, in a recent issue of the *Colorado River Aqueduct News*, publication of the Metropolitan Water District of Southern California. This record represents official Weather Bureau measurements made in Los Angeles, and the still lower figure of 7.1 in. was officially recorded at the Los Angeles Municipal Airport. Such amounts of rainfall are considered normal for desert areas only.

According to Mr. Elder, not only do these two-years establish a new drought record for the period of observation since 1878, but all available data, including precipitation studies going back to 1769, indicate that they constitute the worst dry period since the first Spanish settlement in California 180 years ago.

Pointing out that the present precipitation deficiency really extends back to March 1944, since which time the local rainfall has been continuously subnormal, Mr. Elder states the accumulated deficiency of the present sustained drought is now 24.5 in., or an amount equal to about 20 months of normal rainfall. He describes the situation as even more serious, when runoff and effective percolation to groundwater storage are considered.

Effect of Engine Vibration on Runways Discussed in "Out at the Airport" Series

EXHAUSTIVE STUDIES MADE by the Army Corps of Engineers to determine the extent to which airport pavements are adversely affected by the vibratory action of airplanes standing with their engines idling reveal that, "pavement deflections produced by a B-29 plane, empty and loaded, and standing with motors running were, on an average, about 92 percent of those with the plane standing with motors dead." Similarly, it was found that, "pavement deflections produced by a B-29 plane, empty and loaded, and taxiing were, on an average, about 78 percent of those with the plane standing and motors dead."

These findings are reported in a recent issue of *Out at the Airport*, publication of the American Road Builders Association, which states that the reason is to be found in the law of aerodynamics—aircraft become partially airborne when taxiing. To a lesser degree, as shown in the foregoing percentages, these principles come into play even when aircraft are standing—only, however, if their motors are running.

A further application of these principles to cover landing aircraft, whose impact loads at such times are less critical than static loads, is also pointed out. According to the Corps of Engineers, "It has been demonstrated by flight tests and performance of many airfield pavements that the impact stresses induced by normal landings are not critical and can be disregarded in design. In explanation of this fact, the traffic on runways is widely dispersed, the total aircraft load during much of the landing and take-off is largely airborne, and a wheel load quickly passes a given point so that the support of the pavement by the subgrade is not rapidly depleted."

The publication emphasizes the fact that similar considerations do not apply to the vibration of buses and other vehicles, and that this factor must be taken into account in the design of city streets. Unless design precautions are taken, pavements will break up "under the staccato rhythm of buses' pounding motors in the form of countless pulsations, causing violent vibration at traffic control points and, more frequently, at loading points. Differing from an airplane's idling motors, the engines on buses are not partially airborne. Consequently, the damaging effect of the vibrating motor is transmitted downward to highway pavements, especially at loading points.

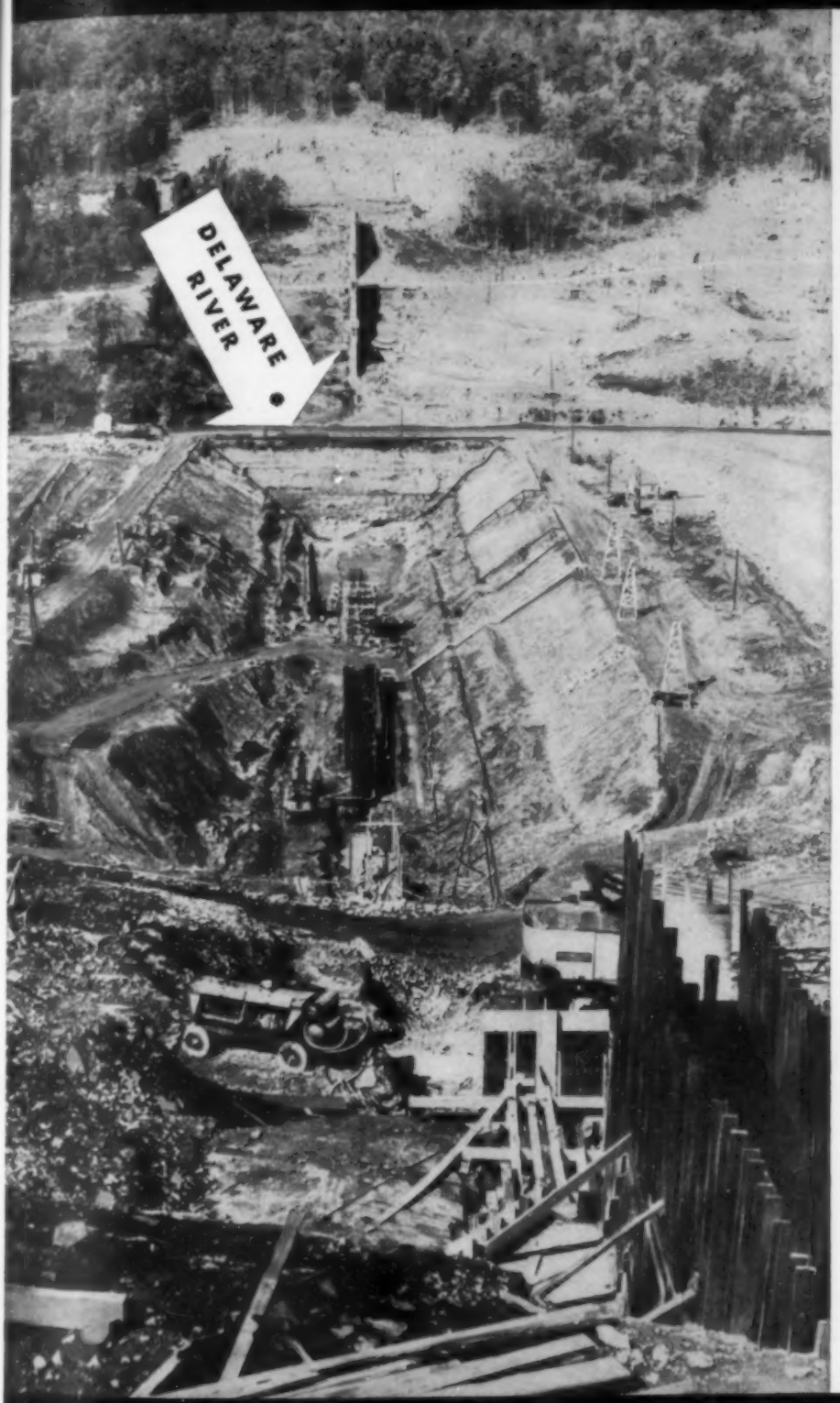
"Added to the damaging effect of repeatedly applied impact loads by buses at stopping points, the vibration of buses' idling engines is regarded as extremely harmful to street pavements of usual design underlying points where buses are scheduled to stop. Vibrometers installed at such points would reveal a high order of vibration frequency range at these locations."

The publication concludes that problems arising in the design of airport pavements, "contrary to earlier thinking on the part of some experts, are vastly different from the factors which must be taken into account in planning street and road pavements. While the latter are called on to take more frequent loadings, and are subjected to the damaging action of vibration at certain locations, runway pavements at major airfields must support wheel loads of far greater intensity than are found on streets and highways. As a result of these much heavier loads, runway pavements are usually much thicker than those installed on streets and highways."

Downsville Dam Construction Site Is Flooded

RECENT FLOODS IN UPSTATE NEW YORK pour 75,000,000 gal of water into core-wall excavation for Downsville Dam, part of New York City's new $350,000,000 Delaware River water system, illustrating one of many contingencies contractor copes with in construction work. Article on construction of diversion tunnel and core wall of Downsville Dam, by John S. Macdonald, M. ASCE, appears elsewhere in this issue.

Speaking of dry jobs–



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Members Take Part in ASEE Civil Engineering Program

PARTICIPANTS IN CIVIL ENGINEERING PANEL of American Society for Engineering Education, at recent meeting of Middle Atlantic Section of ASEE in Philadelphia, include (left to right) William P. Butler, M. ASCE, district engineer, Public Roads Administration, Harrisburg, Pa.; John McShain, builder; George Baylor, division engineer, Pennsylvania Railroad; Thomas Buckley, M. ASCE, director of public works, City of Philadelphia; William J. Eney, Assoc. M. ASCE, professor of civil engineering, Lehigh University; and Harry L. Bowman, M. ASCE, professor of civil engineering, Drexel Institute of Technology.

Bureau of Reclamation Announces New Projects

IN ITS *Advance Construction Bulletin* for January 3, the Bureau of Reclamation lists work about to begin on several large construction projects, under the title of "Bid Calls Expected This Month." As usual, the bulletin emphasizes that all data given are subject to revision.

TUNNEL AND ACCESS ROAD
Santa Barbara Project, California

Location: Near Goleta, Calif.
Work: Construction of the 6.4-mile-long, 7-ft-dia concrete-lined Tecolote Tunnel and construction of 1.7 miles of 18-ft-wide access road.

Excavation for tunnel	75,000 cu yd
Excavation for road	70,000 cu yd
Concrete in tunnel	23,000 cu yd
Furnishing and placing steel tunnel supports	1,000,000 lb
Furnishing cement	35,000 bbl
Time Allowed for Completion:	1,400 days

EAST LOW CANAL AND ROCKY COULEE WASTEWAY
Columbia Basin Project, Washington

Location: Near Moses Lake, Wash.
Work: Construction of earthwork, concrete lining, and structures for 14.5 miles of East Low Canal, 4,500 cfs capacity, and earthwork and structures for the 6¾-mile Rocky Coulee Wasteway.

Excavation (all classes)	5,120,000 cu yd
Concrete in lining and structures	167,000 cu yd
Furnishing and placing reinforcing steel	13,200,000 lb
Furnishing and handling cement	250,000 bbl
Time Allowed for Completion:	900 days

HIGHWAY RELOCATION
Colorado-Big Thompson Project, Colorado

Location: About 5 miles northeast of Granby, Colo.
Work: Relocation of 8.5 miles of Colorado State Highway No. 280 (Monarch Lake Road), from Granby Dam toward Monarch Lake, requiring graveling portions of the road and construction of one timber bridge.

Excavation	213,000 cu yd
Furnishing and placing 24- to 48-in. corrugated metal pipe	4,500 ft
Riprap	1,000 cu yd
Furnishing and erecting timber in bridge	35 mbm
Time Allowed for Completion:	375 days

SAVAGE PUMPING PLANT
Missouri River Basin Project, Montana

Location: Near Savage, Mont.
Work: Construction of pumping plant, substation structure, and about 8 miles of canal and laterals for the Savage Unit (Yellowstone Pumping).

Excavation	123,000 cu yd
Concrete	900 cu yd
Riprap	330 cu yd
Furnishing and placing precast concrete pipe	7,000 ft
Furnishing and placing reinforcing steel	105,000 lb
Time Allowed for Completion:	225 days

Canada Proceeds with Record Hydroelectric Expansion Work

CONSTRUCTION OF HYDROELECTRIC developments in Canada proceeded at high tempo in 1948 in the greatest program of hydroelectric expansion in the history of the Dominion, according to a recent survey conducted by the Department of Mines and Resources of the Dominion Water and Power Bureau. Installed capacity, which now totals 10,931,018 hp, was increased during the year by 440,095 hp, the rate of expansion exceeding the yearly prewar average of about 300,000 hp by a wide margin. However, an unprecedented demand for electric energy, resulting from a high level of industrial activity, readily absorbed the output of new plants.

Plants in an advanced state of construction, which are expected to be completed or in partial operation within the next two years, will have a capacity of more than 800,000 hp, and others in the planning or preliminary construction stage will increase capacity by 1,500,000 hp in five years. In addition, long-range plans call for the development of many other sites now under investigation.

Despite additions made to generating capacity in the past year, total production of central stations was slightly under that of 1947, as a result of subnormal precipitation and runoff during the year in a large area of eastern Canada. The high demand for power, in conjunction with the restricted output of plants in the low-precipitation area, caused a shortage of power, particularly in southern Ontario and sections of Quebec.

Construction Standards Set for Veterans' Housing

MINIMUM CONSTRUCTION REQUIREMENTS, designed to assure veterans that the houses they purchase with the aid of G.I. loans are of sound construction, have been established by the Veterans Administration. These construction standards, which apply only to proposed construction for sale to veterans where the VA is asked for preliminary appraisals, are designed to promote good building practice for the mutual benefits of veterans, lenders, and the government, which guarantees the veteran's mortgage. They cover quality of materials, construction techniques, workmanship, installation of necessary home equipment, and related structural details.

Also available to the veteran are site-planning guides, designed to assure useful and practical plotting of building lots; availability of utilities, transportation and essential services; reasonable proximity to schools and stores; proper streets and drainage; and protection of the purchaser against unanticipated future assessments.

2,068 New Steel Bridges Are Being Built in U.S.

NEW STEEL BRIDGES now under construction in the United States total 2,068, according to the American Institute of Steel Construction. Included in this figure are 1,904 highway and 164 railroad structures, with New England and the North Atlantic states accounting for 226 bridges; the Southern states, for 433; the Central states, for 989; the Southwestern area, for 234, and the Mountain and Pacific Coast states, for 186.

Now Ready!

New, enlarged ninth edition

THE ENLARGED, revised ninth edition of "*Design and Control of Concrete Mixtures*" is now available. Write for your free copy today. It is distributed only in the United States and Canada.

This handbook has been a valuable aid to engineers, architects and contractors for more than 20 years. Packed with graphs, tables and illustrations, it helps you obtain quality concrete for any job.

In designing concrete mixtures strength frequently is overemphasized. ***Strength*** is important but it should not overshadow the other two essentials of quality concrete: ***durability*** and ***workability.***

Quality concrete design achieves a balance between all these important requirements:

1. A workable mix that can be placed easily and quickly.
2. Durability to resist the wear of time and weather.
3. Finished concrete strong enough for the intended use.
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Because of concrete's superior qualities and unusual versatility, it is used for more architectural and structural purposes than any other building material.

Concrete is firesafe, decay-proof, storm-proof and verminproof. It lasts so long and costs so little to maintain that it is truly ***low-annual-cost*** construction. With all its rugged structural properties, concrete also can be molded economically into distinctive edifices of lasting beauty.

To obtain the full measure of concrete's advantages requires the right design, proper selection of materials, careful on-the-job control of mixtures, correct placement and curing. "*Design and Control of Concrete Mixtures*" is a handy reference manual that helps you attain this result.

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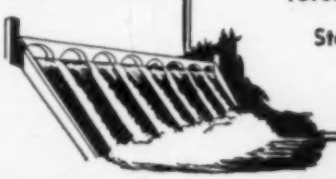

PORTLAND CEMENT ASSOCIATION

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A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

United Nations to Sponsor Conservation Conference

PLANS FOR A United Nations scientific conference on the conservation and utilization of natural resources—to be held in the Metropolitan area, May 16 to June 3—has been announced by UNESCO. Supporting persons and agencies include President Truman, various government departments, notably the Departments of the Interior and Agriculture, and UNESCO.

The principal aim of the conference will be to bring together experts from all over the world for an exchange of experience on the techniques of conservation and utilization of resources. Stating that it has a twofold interest in the conference, UNESCO points out (1) "that a lack of access to natural resources and the wasteful use of existing resources are among the principal causes leading to war," and (2) that "the teaching of the proper techniques for the utilization and conservation of natural resources is a large-scale problem in fundamental education in science."

Inquiries concerning the program and places of meeting should be addressed to the United Nations, Lake Success, N.Y.

Aerial Photography Aids in Highway Location

HIGHWAY ENGINEERS ARE using aerial surveys with great success to aid in making locations, to obtain up-to-date inventories of man-made and natural obstacles, to determine taking-lines for rights-of-way, and finally to show property owners and taxpayers the extent of proposed improvements.

The Massachusetts Department of Public Works has completed an 18-month study to determine how specifications should be drawn so that the resulting pictures will be of maximum value to the project engineer in his work. The study, a joint report of the Project Division of the Department of Public Works and the Institute of Geographical Exploration of Harvard University, reports experience with aerial photographs taken along designated routes where actual planning was in progress..

Wherever recent United States Geological Survey Maps are available, aerial surveys should be planned to amplify data shown on them, and should be used in conjunction with them. In difficult locations, a 5-ft contour map prepared by the Brock Process or the stereoplanigraph furnishes an economical solution.

Experience with the different types of pictures and mosaics made during the study leads to the following conclusions in the report:

1. Most suitable taking scale: urban, 400 ft per in.; rural, 600 ft per in.

2. Normal enlargement 3 diameters; in critical areas 4 to 6 diameters.

3. Use aerial cameras with focal length of 12-in. or more.

4. Plan taking photographs when leaves are off trees and there is no snow on the ground.

5. Panchromatic film is most suitable for black and white photography, with filter suited to haze conditions; where high buildings cast long shadows in urban areas, yellow filter only is suitable. Infra-red film gives poor results.

6. Color photographs are not needed by planning engineers, but may be justified for use in public hearings.

7. Contact prints should be made on double-weight smooth lustre paper.

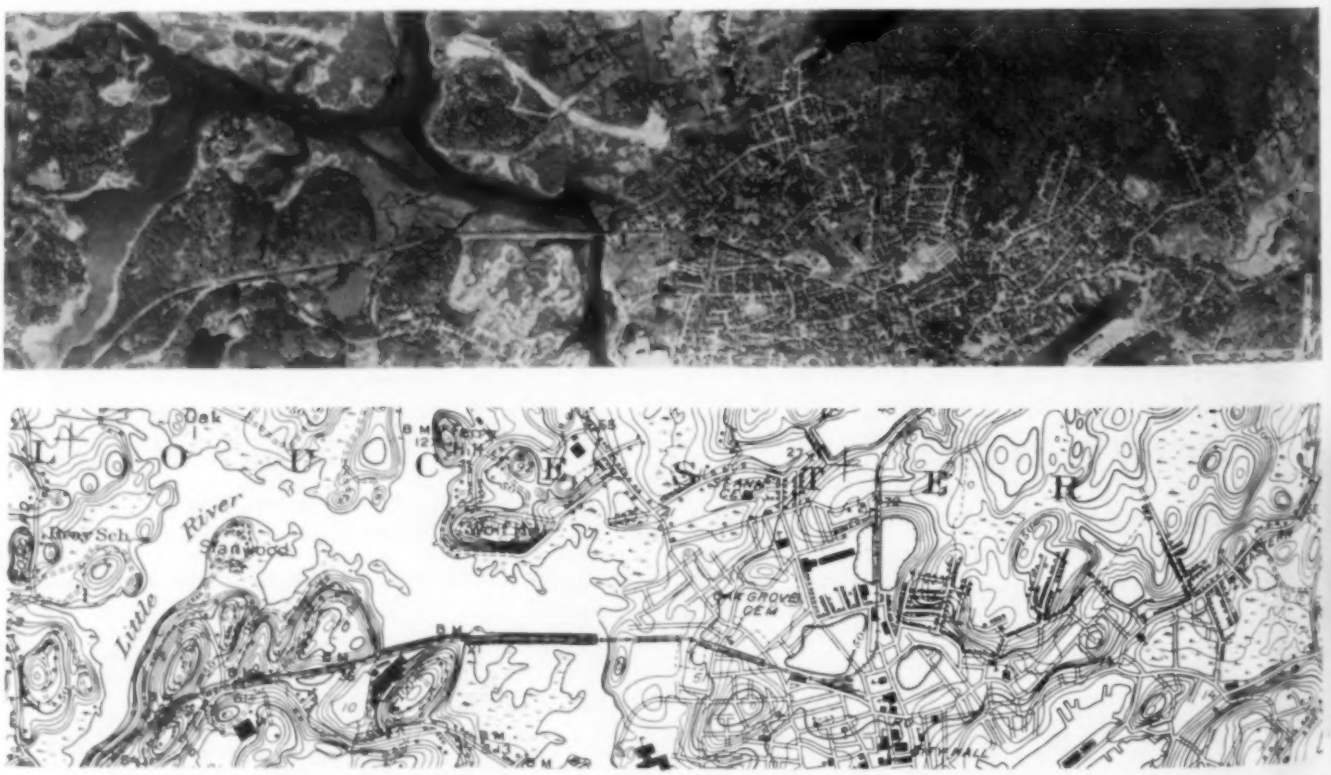
8. Negatives must be clearly marked with order number of the project and, for each separate negative, with a serial number indicating the sequence of its exposure. Flights and each exposure should be indexed on a large map, a USGS sheet if available.

9. Controlled or semicontrolled mosaics often prove adequate, but in difficult locations a controlled mosaic is needed.

10. Topographic information along the right-of-way may be presented (1) by reproducing the contours of a USGS sheet beside the mosaic, or (2) by reproducing them on a transparent overlay kept in register with the mosaic. Neither method is entirely satisfactory.

11. Oblique photographs are useful in planning interchanges, and in public hearings to show proposed taking lines.

The report, which also contains specifications for aerial surveys by contract, is the work of Edward S. Wood, Jr., Institute of Geographical Exploration, Harvard University, and Elmer C. Houdlette, Director of Surveys, Massachusetts Department of Public Works, Boston, Mass. Copies of the report are not available at present.



HIGHWAY SURVEY COSTS ARE REDUCED by Aerial Mapping. Mosaic of Gloucester, Mass., showing actual detail (reproduced in upper view), may be compared with enlarged U.S. Geological Survey map, indicating contours, shown in lower photo.

View showing truss erection nearing completion. Erection was by locomotive crane and stiffleg derrick. Closure at center, top chord section was made by jacking at near end of trusses.

Bridge designed for Cooper's E-65 loading to current AREA Specifications. Estimated weight 600 tons.

Progress photo showing traffic maintained during erection.

New bridge "swallows" old

Rail traffic was uninterrupted when American Bridge Company erected this 190′ double-track truss span around the old span across the Boyer River near Arion, Iowa.

In addition to designing, fabricating and erecting this and two other nearby bridges for Chicago and North Western Railway Company, American Bridge removed the three old spans.

We cite this project as further evidence that for fabrication and erection efficiently done, you can depend on American Bridge.

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General Offices: Frick Building, Pittsburgh, Pa.
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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

AMERICAN BRIDGE

UNITED STATES STEEL

Survey Shows Covered Bridges Are Not Obsolete

COVERED BRIDGES ARE still an important factor in the transportation system of the country, according to the American Road Builders' Association. Following a recent study, the ARBA points out that these structures are still giving satisfactory service on secondary roads from Maine to Oregon, despite the fact that they were not built according to modern engineering plans.

Contrary to popular belief, covered bridges did not originate in the United States. One of the oldest on record is located in Switzerland, and they may be found in rural sections of both Europe and Asia and in many parts of Canada. The first in this country was built in Pennsylvania in 1771. From there, this type of construction spread to New England, where it flowered about 20 years later.

New England still has almost 300 usable covered bridges, although many were lost in the disastrous flood of 1927. Despite its small size, Vermont with 170 ranks fourth among the states having the most still in service. Ohio, with 592 covered bridges carrying a daily traffic load, is placed first. Pennsylvania ranks second with 336, and Indiana third with 194. The 21 other states, where they are still in use, include California and Oregon. According to the ARBA, actual figures are difficult of compilation, because many of the bridges are now privately owned. In other instances, the structures have been preserved by conversion into museums or storehouses, after outliving their usefulness as bridges.

Improvements in construction have been made through the years, but the practice of roofing the bridges to protect the timbers has continued. There are also wide variations in style in different parts of the country. Oregon favors white bridges, with green roofs and Gothic-type windows, in contrast to their rustic New England forerunners. Some California structures also depart from the prescribed style in having iron roofs. Oil-impregnated wooden pegs, formerly used to hold planks and studding together, have been replaced by iron nails and bolts, but in almost all cases the load capacity of the bridges is found to be substantially above that anticipated by the original designer. Standard doorway dimensions were the height and width of a load of hay.

The hardiness and utility of the covered bridge are demonstrated by the fact that, though many of them have been destroyed by floods, many others have withstood severe freshets. Intact, a covered bridge will often float down a swollen stream, to be salvaged later and reset on its original abutments or relocated.

Field Offices for Control of Pollution Designated

TO IMPLEMENT THE provisions of the Water Pollution Control Act, passed in June 1948, the Federal Works Agency and the Federal Security Agency have announced the location of field and basin offices, through which their water pollution control program will be carried out. Under this law, the Surgeon General of the Public Health Service, under the supervision and direction of the Federal Security Administrator, will provide financial and technical assistance to the states in the formulation and execution of their pollution control programs.

Headquarters of the program will be in the Water Pollution Control Division of the Public Health Service, Washington, D.C. The 14 river basin offices, set up to implement the program in their respective watersheds, will be located as follows: New England area, Boston, Mass.; North Atlantic, New York, N. Y.; Middle Atlantic, Washington, D.C.; Southeast, Atlanta, Ga.; Ohio-Tennessee, Cincinnati, Ohio; Great Lakes, Chicago, Ill.; Upper Mississippi River, St. Louis, Mo.; Missouri River, Kansas City, Mo.; Southwest Lower Mississippi, Little Rock, Ark.; Western Gulf, Dallas, Tex.; Colorado River, Boulder City, Nev.; Great Basin, San Francisco, Calif.; California, San Francisco; Pacific Northwest, Portland, Ore.

Shell Roof Structures to Be Studied at Lehigh U.

A TWO-YEAR RESEARCH project for checking and improving design procedures for shell roof structures has been assigned to the Fritz Engineering Laboratory of Lehigh University by the Roberts & Schaefer Engineering Co., of Chicago, according to an announcement by Dr. Harvey A. Neville, director of the university's Institute of Research.

The investigation will cover experimental and analytical research on the design of shell structures of reinforced concrete of the type used in large airplane hangars or domes of monumental buildings. An article on a huge monolith concrete hangar of this type, being built by the Corps of Engineers at Rapid City, S. Dak., appears on page 34 of the current issue.

Commenting on the need for research work in this country on the improvement of shells in their application to building construction, Bruce G. Johnston, M. ASCE, director of the Fritz Engineering Laboratory, stated that, "Shell structures are among the most efficient and daring of all engineering structures." Considerable research has been devoted to the subject in Europe since the turn of the century, he said, and shell structures are now being used in steadily increasing number in the United States.

Construction Roundup

From the Construction Industry Information Committee—Washington, D.C.

EXPENDITURES FOR PUBLIC works by federal, state, and local governments broke all peacetime records in 1948, totaling $4 billion. The total volume of publicly financed construction since the war ended has reached $10 billion, while in the same period an additional $34 billion has been spent for housing and other private construction.

Public construction in 1948 was more than 75 percent higher than during the years 1936 and 1937, when public works expenditures were being made freely to bolster economic recovery from the depression. Although publicly financed construction has reached a new peacetime peak, in substantial competition with private building for both materials and labor, many less essential projects have been deferred on the theory that such work should be carried out during periods when private building activity begins to slacken.

The largest construction expenditure of the federal government has been for conservation and development, amounting to $615 million in 1948. The largest expenditure of states, counties, and cities has been for highways, amounting to more than $1 billion last year—or twice the federal outlay for that purpose. Highways, roads, and streets, including state and local as well as federal expenditures, have accounted for one-third of all public construction since the war. Other fields of rapid expansion have been school and hospital building and sewer and water facilities.

Since 1945, when much federal war building activity was still going on, federal expenditures have represented less and less of the public construction total. In 1946 the part paid for with federal money was 49 percent of the total bill; in 1947, it was 38 percent; and in 1948, the federal share had dropped to 33 percent.

While the federal share has been dropping, state, county, municipal, and other local expenditures have increased accordingly, as school, road, and utility construction has got under way.

Bibliography on Prestressed Concrete Issued by E.S. Library

ANNOTATED REFERENCES TO literature from all over the world on the subject of prestressed reinforced concrete have been compiled by the Engineering Societies Library and issued as ESL Bibliography No. 2. The present publication covers all phases of the subject, including theory, design, construction practice, and applications, over a 60-year period. Patent literature has not been covered, except for the inclusion of a few of the earliest patents.

Requests for the bibliography, which sells for $4, should be addressed to the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

LONDON and BIRMINGHAM

BRITISH INDUSTRIES FAIR

Britain has long been the world's greatest customer, and has led the way in the export of manufactured products. By initiative in modern research, and from experience of commerce with other nations, her industrial production has become greater and more varied than ever in history.

Renowned for the quality of her work, Britain has applied new technique to her famous industries. By enterprise in fresh markets she has achieved record deliveries, and export production still expands. To keep in touch with these developments great numbers of the world's principal buyers are making visits to Britain.

Every year, from over 100 countries, trade buyers gather at the British Industries Fair. The Chamber of Commerce in Birmingham, and manufacturers from every part of Britain, join with the British Government to welcome them.

At BIF 1949, from 2–13 May, three thousand exhibitors will display the latest developments in thirty groups of allied trades. The leading men of international commerce are invited to attend the world's greatest assembly of national products.

2-13 MAY 1949

TRADE BUYERS—PLAN YOUR VISIT NOW

Information about exhibitors, special displays and facilities at the Fair can be obtained from the nearest British Embassy, Legation or Consulate.

R. Robinson Rowe, M. ASCE

JOE KERR WAS all smiles. He looked like the cat that had just swallowed the canary and didn't care who knew it, but as a matter of fact he was just a schoolboy satisfied that his homework was correctly done. His smile broadened as the Professor rose and looked his way; this would be his big moment.

Sure enuf. He was called on to write the homework on the blackboard and discuss it. He wrote confidently:

tru·man = *yyyyyy*	407·819 = 333,333
f·thomas = *aaaaaa*	7·126984 = 888,888
aaa·bbcc = *dddddd*	777·1144 = 888,888
oo·moon = *tttttt*	77·5772 = 444,444
ina·hive = *bbbbbb*	259·1287 = 333,333
ina·pod = *pppppp*	814·273 = 222,222

abbc·acd = accd·abc = eeeeee 1554·143 = 1443·154 = 222222

"There isn't much to discuss, Professor. There are 320 ways of factoring the 9 numbers with 6 equal digits. I wrote them all out and picked the ones that fit."

"Joe's right, but he did it the hard way," said Cal Klater. "For example, the first one can be written *tru·man* = 3·7·11·13·37*xz*, where *x* and *z* are factors of *y*. With 6 different digits, *tru* and *man* are interchangeable. Let *tru* contain 37*x*; then it cannot contain 3 also, or its 3 digits would be alike. It must, however, contain just one of the factors 7, 11 and 13 to have just 3 digits in both *tru* and *man*, so the options for *tru* are 259*x*, 407*x* and 481*x*.

"Since *x* = 1 would make *n* = *y*, we have just 5 trial factors: 259, 407, 518, 814 and 962. The corresponding trials for *man* are: 429*z*, 273*z*, 429*z*, 273*z* and 231*z*. All can be eliminated by inspection for duplication of some digit, except the second with *z* = 3 which gives Joe's answer uniquely.

"I might add that the others are much easier, except for the bees-in-a-hive and peas in-a-pod, and for these the real problem was proving the solutions were unique."

"Exactly, Cal, and I'll confess that I had to set up Joe's table of 320 factorizations to select 7 problems that would be unique. Our next problem involves the mathematical sense of animals, and altho we credit the amoeba with division, the hare with multiplication and the ape with evolution, Guest Professor Parker Piper will make an actuary out of a wharf rat."

"He was a rather rare rat, Noah, in a well-organized horde directed by a general staff. His G-4 located forage on a roof and mapped alternative routes from the HQ on the wharf via the skeleton frame of an intervening new building. The frame was 4 bays wide by 10 bays long, complete with all columns and main floor girders from first floor to roof, but nothing else. All routes were of equal length from the lower NE corner at HQ over any progressive combination of columns and girders to the upper SW corner opposite the forage. His G-2 laid out a different route for each rat for each night without duplication or omission, but this Chief Rat had to postpone the foray until 1952 in order to complete the mission in just a month. How many rats were there?"

[Guest Professor Parker Piper is Julian Hinds. The Cal Klaters were: A Nuther Nutt (anon), Kum Pewter (Walter Steinbruch), Robert H. Cummings, Richard Jenney, M. L. Button, Count Harvey, John L. (Stoop) Nagle, H. Herbert Howe, R. E. Philleo, Anne Othernut (J. Charles Rathbun), Abraham Bodenstein, C. P. Marsh, and Victoria Masce (J. S. Kendrick), besides last-minute solutions of the desk-around-the-ell problem from A Nuther Nutt, Homer W. Woodbury, and Prof. Jen Tung Wang.]

Positions Announced

Army Corps of Engineers. Applications are being reviewed for the newly created position of Director of Research and Development at the Engineer Research and Development Laboratories, Fort Belvoir, Va., as announced by the commanding officer, Col. John C. Arrowsmith. This position is open to persons with at least 15 years' experience, exclusive of graduate work, 10 of which should have been in research or as a research or development engineer, and 5 as chief of a branch or department of a research and development organization with administrative and technical responsibility. The salary is $12,500 a year. Qualified persons should make application either in person or by letter to the Commanding Officer, Engineer Research and Development Laboratories, Fort Belvoir, Va.

NEW IN Education

A THREE-DAY Seminar on Public Support Program Planning will be held at the University of California, February 9–11, as part of the first Western Institute for Traffic Training. Sponsored jointly by the university's newly organized Institute of Transportation and Traffic Engineering and the National Committee for Traffic Safety, the Institute initiates a program which contemplates five or six regional traffic safety conferences, to be held throughout the country each year. Inquiries should be addressed to the Department of Institutes, University Extension, University of California, Berkeley 4, Calif.

TO PERMIT CLOSER coordination of instruction and more effective use of the elaborate equipment required in the materials field, Cornell University has consolidated two of its engineering divisions in a new Department of Engineering Materials. D. F. Gunder, Assoc. M. ASCE, professor of mechanics, has been named acting head of the new department, which incorporates the former departments of engineering materials in the School of Civil Engineering and the Sibley School of Mechanical Engineering.

APPLICATIONS FOR FELLOWSHIPS, scholarships, and assistantships for graduate study, research, and teaching at the Illinois Institute of Technology will be accepted until March 15, 1949, according to an announcement from Dr. W. A. Lewis, dean of the graduate school. Fellowships are available in special fields of study—power plant engineering, gas technology, and industrial research. Scholarships covering tuition are available for exceptional students, and teaching assistantships are open in all de-

Meetings and Conferences

American Concrete Institute. Headquarters for the 45th annual convention of the American Concrete Institute will be the Hotel Statler, New York City, February 23–26. The program will cover important concrete problems in connection with road building, and the design and construction of buildings.

American Institute of Chemical Engineers. A regional meeting of the American Institute of Chemical Engineers will be held in Los Angeles, Calif., March 6–10.

American Institute of Mining and Metallurgical Engineers. Technical sessions and field trips by air and land are planned for the 77th annual meeting of the American Institute of Mining and Metallurgical Engineers, San Francisco, Calif., February 13–17.

American Road Builders' Association. Construction methods, practices, policies, and equipment, developed during 1948, will be presented at the 46th annual conference of the American Road Builders' Association at the Hotels Mayflower, Statler, and Willard, in Washington, D. C., February 7–9.

American Society of Tool Engineers. New developments and problems in the tool engineering and related fields will be discussed at the 17th annual meeting of the American Society of Tool Engineers scheduled for the Hotel William Penn, Pittsburgh, Pa., March 10–12.

American Society for Testing Materials. Spring meeting at the Edgewater Beach Hotel, Chicago, March 2.

National Association of Home Builders of the United States. The fifth annual convention and exposition of the National Association of Home Builders is to take place in the Stevens Hotel, Chicago, Ill., February 20–24.

Painted for U. S. Pipe & Foundry Co. by Paul Laune

U.S. cast iron PIPE

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partments. The stipend for halftime assistants is $1,314, from which $275 tuition is payable. For assistants giving one-third of their time to teaching the stipend is $876, from which $412.50 tuition is payable. Applications should be addressed to the Examinar of Credentials, Graduate School, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

A SERIES OF lectures covering many types of instruments related to research and their application has been scheduled by the Research Division of the New York University College of Engineering, according to an announcement by Dean Thorndike Saville, M. ASCE. The purpose of the lectures is to acquaint all members of the research staff with basic theory and with modern developments in so far as they affect the work at the college.

SPONSORED RESEARCH CONDUCTED by the Armour Research Foundation of Illinois Institute of Technology during the past year reached a new high, according to the Foundation's annual report. Stating that the Foundation's research service was the most extensive and active in its 12-year history, with an approximate increase of 25 percent over the previous high year of 1946–1947, the report describes 185 projects undertaken in the past year for industrial organizations, government agencies, and several foreign countries. A gross expenditure of $3,400,000 for sponsored research for the year is reported.

ANNOUNCING ITS 16th annual program of fellowships for graduate study in engineering, Tau Beta Pi calls attention to awards available for the school year 1949–1950. In some cases, it may be possible to augment the fellowships, which amount to $1,200, payable in ten monthly installments, by obtaining a remission of most or all of the tuition fees of the school of the recipient's choice. All Tau Beta Pi members are eligible. Additional information on the program may be obtained from Paul H. Robbins, Director of Fellowships, 1121 Fifteenth St., N.W., Washington 6, D.C.

Proceedings of Soil Conference Are Issued

DEVELOPMENTS IN EARTHWORK engineering in the past dozen years and a complete survey of modern design and construction methods are covered in the recently issued Proceedings of the Second International Conference on Soil Mechanics and Foundation Engineering, held at the Hague, Netherlands, in June 1948. The Proceedings consist of six quarto volumes of about 330 pages each, and a seventh is planned if sufficient orders are received in advance. The latter will contain 41 papers from all parts of the world, plus 23 papers prepared as a group by French engineers and published in *Travaux* for June 1948, which were received too late for inclusion in the other volumes.

Orders should be sent to the Secretary, Second International Conference on Soil Mechanics and Foundation Engineering, Oostplantsoen 25, Delft, the Netherlands. The cost of Volume I to VI will be 75 guilders (approximately $28.30), and Volume VII will be 15 guilders (approximately $5.65). Remittances should be sent with orders in the form of bank drafts, payable to the Treasurer of the Conference, care of Amsterdamsche Bank, Delft. Orders for Volume VII should be placed as promptly as possible, because the number printed will depend on orders received.

Although German engineers were unable to participate in the Conference because of travel and other restrictions, they have collected the German developments in soil mechanics and foundation engineering since 1939 into one 215-page volume, *Abhandlungen ueber Bodenmechanik und Grundbau, 1939–1948*. Arrangements are being made to sell this volume through the library of the Graduate School of Engineering, Harvard University, Cambridge, Mass. Funds realized from its sale will be used to purchase the Proceedings of the Second International Conference and American soil mechanics publications for German libraries.

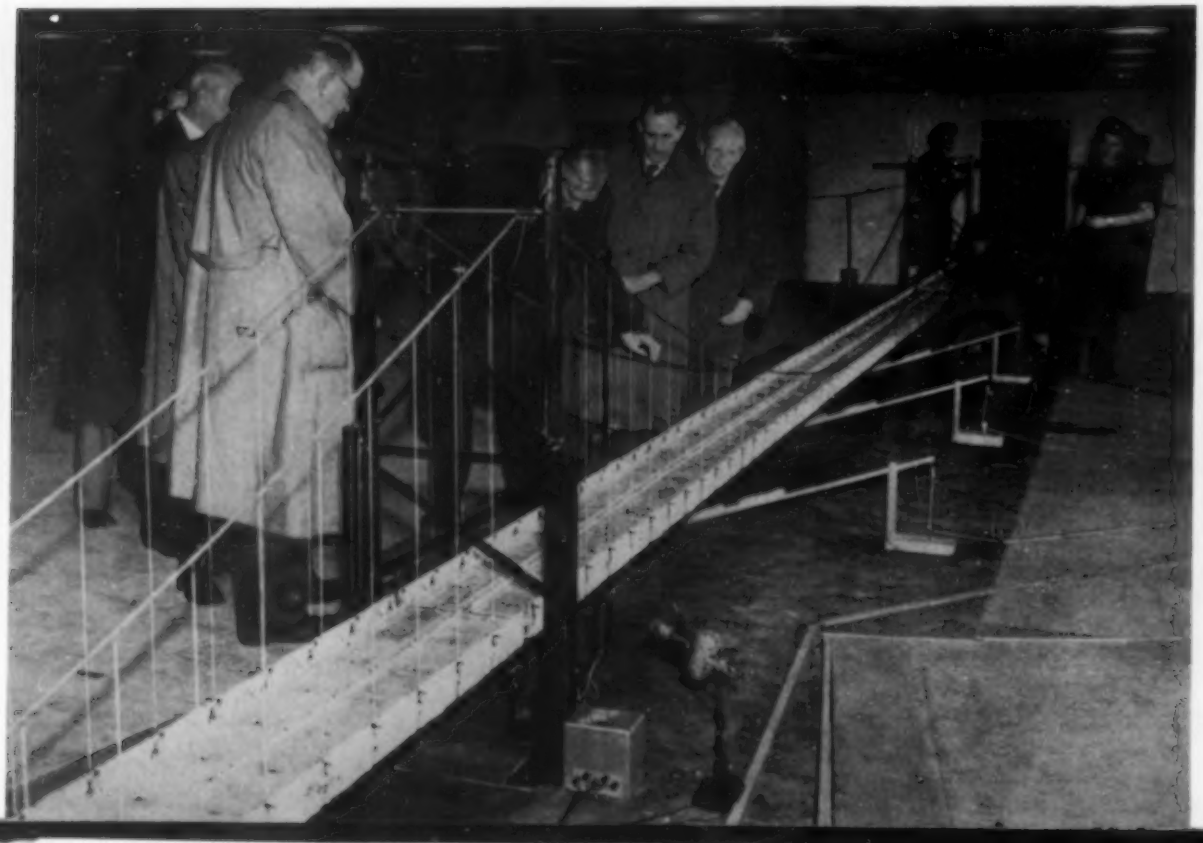
New Publications

UNESCO Activities. Bulletin No. 8 of the Committee on UNESCO of the National Research Council has been made available to acquaint scientists and the general public with the activities of the Natural Sciences Division of UNESCO and with scientific projects in the field of international relations. Copies are obtainable from the Committee at 2101 Constitution Avenue, Washington 25, D.C.

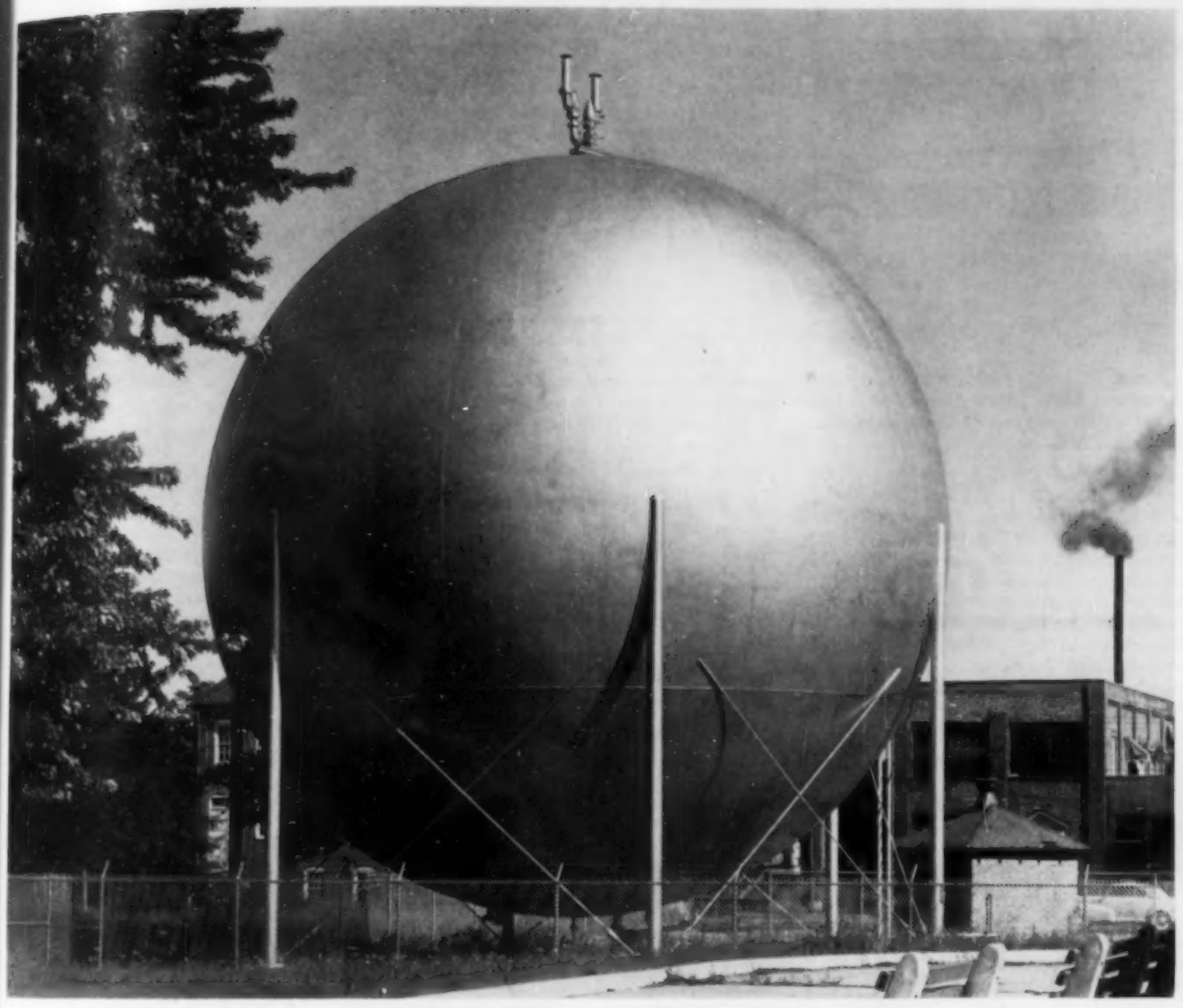
Construction Publications. Basic sources of government and other information in the building and construction field have been compiled by L. W. Cain, of the Inquiry Reference Service of the U.S. Department of Commerce, in a new Department bulletin entitled *Building and Construction*. Inquiries should be addressed to the Department of Commerce, Washington 25, D.C.

(*Continued on page 94*)

Europe's Largest Suspension Bridge Is Model Tested in Wind Tunnel



WIND TUNNEL TESTS to determine final shape of Severn suspension bridge are being made by group of engineers and scientists from Aerodynamic Division of National Physical Laboratory. Specially designed tunnel, built in unoccupied hangar at Thurleigh, Bedfordshire, England, houses 52-ft model, on which it is possible to observe effect of wind blowing from any direction. Completed structure will be largest suspension bridge in Europe and third largest in world. Photo through courtesy of British Information Services.



Breathing new life into gas distribution systems

The Hortonsphere is breathing new life into the overworked distribution systems of public gas companies, to help the systems meet the increasing customer demand for cooking and heating gas. All along the line in gas production and handling, these pressure containers are effectively enlarging the capacity of gas systems, by holding supplies in reserve until needed—by smoothing out the contest between steady production and uneven demand. At central and district gas plants, for example, Hortonspheres hold standby supplies for times when gas production lags behind demands, or for emergencies when production is interrupted.

Distribution systems are also equipped with Hortonspheres—as a means of maintaining uniform pressures during periods of peak demand, and are usually fitted with automatic regulators which control the flow of gas in and out of the reserve gas holder. A similar use is made of Hortonspheres on long high-pressure transmission mains supplying distant communities.

Hortonspheres are readily adaptable to jobs requiring pressure in the range between 20 and 100 lbs. per sq. in. Besides gas utility service, Hortonspheres are used by other industries for storing such products as anhydrous ammonia, hydrogen, and carbon monoxide—wherever dependable, easily-maintained pressure holders are required. Sizes are from 20 to 65 ft. in diameter. Ask our nearest office for details.

Above view: A 38 ft. 7 in. diam. Hortonsphere storing reserve gas at the South New Jersey Gas Company's Egg Harbor plant.

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Los Angeles 14.....1456 Wm. Fox Bldg.
New York 6.....3395-165 Broadway Bldg.
Philadelphia 3...1652-1700 Walnut St. Bldg.
Salt Lake City 1..1509-1st Security Bk. Bldg.
San Francisco 11..1284-22 Battery St. Bldg.
Seattle.....1309 Stuart Bldg.
Tulsa 3.....1647 Hunt Bldg.

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NEWS OF Engineers

Sol Resnick has completed service with the counter-intelligence section of the U.S. Army and is doing graduate work at the University of Wisconsin toward a master's degree.

James W. Bradner, Jr., previously town manager of Norris, Tenn., has become connected with the Galveston Broadcasting Co., Galveston, Tex.

Edward P. Albright is president of the newly formed Albright Foundation Corp., 1245 Madison Avenue, New York City. The concern will be engaged as engineering contractors in the field of underpinning and difficult foundation work. Since 1922, Mr. Albright has been with the Underpinning and Foundation Co., Inc., New York City, in the capacity of engineer and contract manager. **Frances Bartoccini** will act as vice-president of the corporation and will continue to head his own general contracting firm.

A. L. Alin, consulting engineer of Omaha, Nebr., has been appointed to a part-time position as professor of hydraulic engineering at the State University of Iowa. Professor Alin will give a graduate course in the design of dams while continuing his consulting practice.

Carl Bennett, previously director of public works and planning at Grand Junction, Colo., has assumed the duties of assistant city engineer for Colorado Springs, Colo.

Harrison F. Gonnerman, until recently director of research, Portland Cement Association, Chicago, Ill., has been advanced to the position of assistant to the vice-president for research and development, succeeding **F. R. McMillan,** who has retired after 24 years with the association.

John W. Graham, Jr., formerly assistant professor of civil engineering at the Carnegie Institute of Technology, has been named assistant to **Dr. Webster N. Jones,** director of the Institute's College of Engineering and Science.

John F. Hall has been made district engineer in charge of the Portland Cement Association's New York office, succeeding **E. M. Fleming** whose request for retirement has been granted. Mr. Fleming has been on the Association's staff for over 22 years. As district engineer, Mr. Hall will direct field promotion in the states of Connecticut, New York, and New Jersey.

J. S. Minnotte has been transferred to the position of assistant chief of the construction division and head of the project control branch of the Pittsburgh, Pa., District of the Army Engineers' office, from resident engineer of the Olean, N.Y., Flood Protection District.

George F. Nicholson, consulting engineer, announces that his Los Angeles office has been moved to 800 Kress Building, Long Beach, Calif. His policy of specializing only in harbor and waterfront engineering design and construction and beach preservation will be followed.

Emil Schaeffer has been appointed chief engineer of the tower division of the Elizabeth Iron Works, Elizabeth, N.J. As chief engineer, Mr. Schaeffer will have charge of the design and construction in connection with structural steel fabrication dealings.

R. H. Stock, president of Stock and Grove, Inc., Anchorage, Alaska, has been elected president of the Anchorage chapter of the Associated General Contractors of America. **E. W. Dunn,** who is with the Birch, Johnson and Lytle, Co., was delegated manager of the chapter.

S. L. Taylor, previously division engineer of the Public Roads Administration in charge of Division 5-North at St. Paul, Minn., was transferred to Washington, D.C., where he will be responsible for Division 2 activities. **Walter V. Buck,** who was head of the design section in Division 2, at Washington, D. C., will assume new duties as division engineer at the St. Paul, Minn., office.

Ralph B. Wiley, head of the School of Civil Engineering, Purdue University, Lafayette, Ind., and ASCE Vice-President from Zone III, was unanimously selected by the awards committee of the Indiana Sewage Works Association to receive the 1947 citation for "outstanding contributions" to Indiana's sewage treatment. The award was made at a recent meeting of the Association in Indianapolis.

Charles R. Velzy, previously resident engineer for the Buffalo Sewer Authority on the sewage treatment plant and pump stations, has joined the engineering company of Nussbaumer, Clarke and Velzy, Inc. Mr. Velzy will have charge of the firm's New York office.

Vincent B. Lamoureux was transferred from the U.S. Public Health Service District No. 1, New York, N.Y., to the National Security Resources Board, Washington, D.C.

W. R. Rogers, previously on duty as a lieutenant (jg) with the Navy Civil Engineer Corps at Alaska, is now at San Francisco, Calif., attending a special school on harbor installations at Fort Scott.

Reuben R. Alvy has left the bridge department of the California State Division of Highways to go to the division of architecture in Sacramento.

Lloyd Thomas has been transferred from the design and construction section of the Bureau of Reclamation at Sacramento, Calif., to its office at Grand Island, Nebr.

Clayton O. Dohrenwend was appointed to the newly established post of assistant director of the Midwest Research Institute, Kansas City, Mo. Since 1946, Dr. Dohrenwend has been research consultant. Prior to his affiliation with the Institute, he directed the Mechanics Department at the Illinois Institute of Technology.

Ladis H. Csanyi will become a professor on the civil engineering staff at Iowa State College on March 1. Previously connected with the Edwards & Kelcey consulting concern of New York City, Mr. Csanyi directed special projects on traffic studies and highway designs. As an engineer with the Department of Borough Works, Manhattan, he was in charge of studies and the design of traffic facilities for the Battery Tunnel Underpass and Brooklyn-Battery Tunnel Plaza Underpass.

Verne Gongwer, formerly chief engineer of construction for the Department of Public Utilities, Tacoma, Wash., is now employed in the Portland, Ore., office of the U.S. Engineer Corps.

Robert J. Potts has joined the staff of the Texas Highway Commission. For several years, he has been professor of highway engineering at Texas A. and M. College. Mr. Potts is serving his second year as president of the Texas Good Roads Association.

Joseph J. Rosa has accepted the position of resident engineer of the New Bunswick, N.J., laboratory of Knappen Tippetts and Abbett Engineering Co.

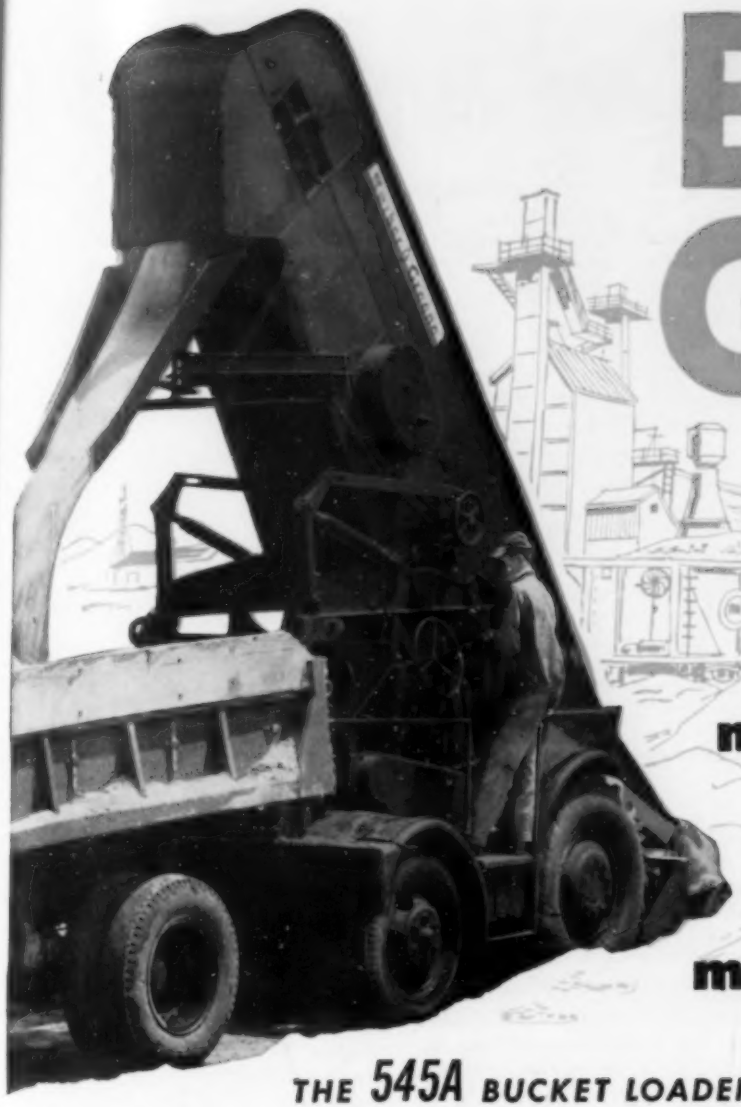
Leon Hyzen is enlarging his architectural, store planning, and industrial design practice. The firm's new office has been established at 1129 North Dearborn Street, Chicago, Ill.

O. W. Swainson, supervisor of the western district of the U.S. Coast and Geodetic Survey, is retiring after serving the Survey for 38 years.

Jerome Fertig, who has held the position of engineer with the Bureau of Reclamation at Santa Barbara, Calif., has been made chief of the Development Division in the same office.

COL. W. G. BUECHLER, Jacksonville, Fla., consultant (left) is first Floridian to receive direct commission in Army Civil Engineer Corps under new military organization setup. Oath is administered by Col. R. G. Howie, commanding officer. Col. H. W. Tarkington shown in center.

Barber Greene



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Every feature in the rugged Barber-Greene Model 545A Bucket Loader helps you to get more yards moved per hour, more jobs done per day.

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It's a great time-saver—fast on the road, fast on the job. Notice how the boom nestles horizontally for transport, and how it reduces overall height. Boom can be tilted onto saddle quickly and easily without using a wrench. Takes only a few minutes to get ready to move.

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Charles P. Gross, formerly deputy transport officer at Frankfort, Germany, will succeed **Charles M. LaFollette** as director of the Military Government in the State of Wuerttemberg-Baden, with headquarters at Stuttgart. Upon graduating from the U.S. Military Academy at West Point—the third highest in the class of 1914—Mr. Gross joined the Corps of Engineers, where he was elevated to colonel during World War I. At the time of his retirement from the Army in 1945 after 35 years with the Corps, he was wartime chief of the transportation corps and had attained the rank of major general. General Gross served as chairman of the New York City Board of Transportation from 1945 until his resignation in October 1947.

Charles P. Gross

Leonard D. Norsworthy, since 1942 assistant chief of the engineering division of the Office of the Chief Engineer, Washington, D.C., has retired.

Alden G. Roach, until recently president of Consolidated Steel Corp., Ltd., Los Angeles, Calif., has been appointed engineer-president of Columbia Steel Co. at Pittsburg, Calif.

Louis M. Buja, formerly office engineer for the city engineer of New Orleans, La., has been named principal assistant in the city engineer's office.

James Lambeth is acting city engineer of Raleigh, N.C.

Charles Dahlgren has been made assistant professor in the engineering department at Gustavus Adolphus College and city engineer of St. Peter, Minn.

Clifford Hamblin has been appointed acting city engineer for Mason City, Iowa. Previously Mr. Hamblin served the same municipality as superintendent of the water works and disposal plants.

Horace P. Warren, engineer conducting the Operations Division of the Rock Island Engineer District of the Corps, has retired after serving over 30 years. He is a charter member of the Tri-City Section of the Society.

ASCE Past-President R. E. Dougherty, vice-president-assistant to the president of the New York Central System, has retired after 46 years of active duty. Mr. Dougherty will continue to serve the System in an advisory consulting capacity. During his affiliation with the New York Central, Mr. Dougherty directed many engineering improvements and developments on the railroad, including the Park Avenue and West-side improvements in New York City, the Cleveland Union Terminal, and the Buffalo Central Terminal. He will be succeeded by **Boynton S. Voorhees,** who has been with the organization for 40 years, as assistant engineer on grade crossings, district engineer of the eastern division, general office engineer, and engineering assistant to vice-president on improvements and development.

Jacob Latch Warner, who retired as special assistant in the service department of the E. I. duPont de Nemours and Co., Wilmington, Del., in January 1946, is engaged as an officer by approximately 12 companies and is active in civic and social work. He helped form and served as the first president of the Old Guard Club, which suggests useful work and hobbies for retired engineers and businessmen.

Harry S. Stanton, field project manager for the E. I. duPont de Nemours and Co. of Wilmington, Del., has retired. While with the duPont Co., Mr. Stanton was responsible for many major construction projects.

James T. Holden, of Granville, Ohio, will serve as engineer for Licking County, New Jersey, with headquarters at Newark, completing the unexpired term caused by the death of **Earl Watkins.**

Harold A. Stepleton announces the establishment of an engineering concern under his own name, which will specialize in treatment and disposal plants. His office will be located in the Spitzer Building, Toledo, Ohio.

Eugene W. Weber, since 1930 in the engineer Corps of the Army, has been named a member of the United States Section of the International Joint Commission, United States and Canada.

H. G. Wood, formerly field engineer of the Portland Cement Association at Columbus, Ohio, has accepted the position of statewide paving engineer for the organization with headquarters at the same place.

New officers of the Public Works Association include ASCE members **William S. Foster,** engineering editor of the *American City Magazine*, New York, N.Y., and **W. O. Jones,** city manager of Fort Worth, Tex., directors; **Walter N. Frickstad,** city engineer, Oakland Calif., Western area vice-president; and **E. J. Cleary,** executive director and chief engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Eastern area vice-president.

Edward J. Cleary has resigned as executive editor of *Engineering News-Record*, with headquarters in New York City, to accept the position of executive director and chief engineer of the Ohio River Valley Water Sanitation Commission at Cincinnati. On the *News-Record* staff since 1935, Mr. Cleary has written widely on many phases of public works construction and administration and, during the war, was accredited as a war correspondent to report for his magazine on Army and civilian construction projects in strategic areas of South America. Active in Metropolitan Section affairs, Mr. Cleary recently served as general chairman of the 1949 Annual Meeting Committee. He is vice-president of the American Public Works Association.

Edward J. Cleary

Deceased

Arthur Perry Banta (M. '43) associate professor of sanitary engineering at California Institute of Technology, Pasadena, Calif., died suddenly at his home there on January 23. He was 44. Professor Banta had served as sanitary engineer for the Los Angeles County Sanitation Districts, and since 1938 had been on the Caltech staff. The author of numerous articles reporting results of research on sewage tansportation and treatment, Professor Banta received the Society's James Laurie Prize in 1940. During the war he served in the Pacific theater as a lieutenant colonel in the Corps of Engineers and was decorated with the Bronze Star Medal.

Charles Carroll Brown (M. '95) consulting civil engineer of Lakeland, Fla., died there on November 26. From 1886 to 1893 Mr. Brown was in charge of the Union College civil engineering department, and consulting engineer for the New York State Board of Health. He served as editor of *Municipal Engineering* from 1896 to 1917 and, during that period, also maintained a consulting practice in Indianapolis. Later he was city engineer of Indianapolis and of St. Petersburg and Lakeland, Fla.

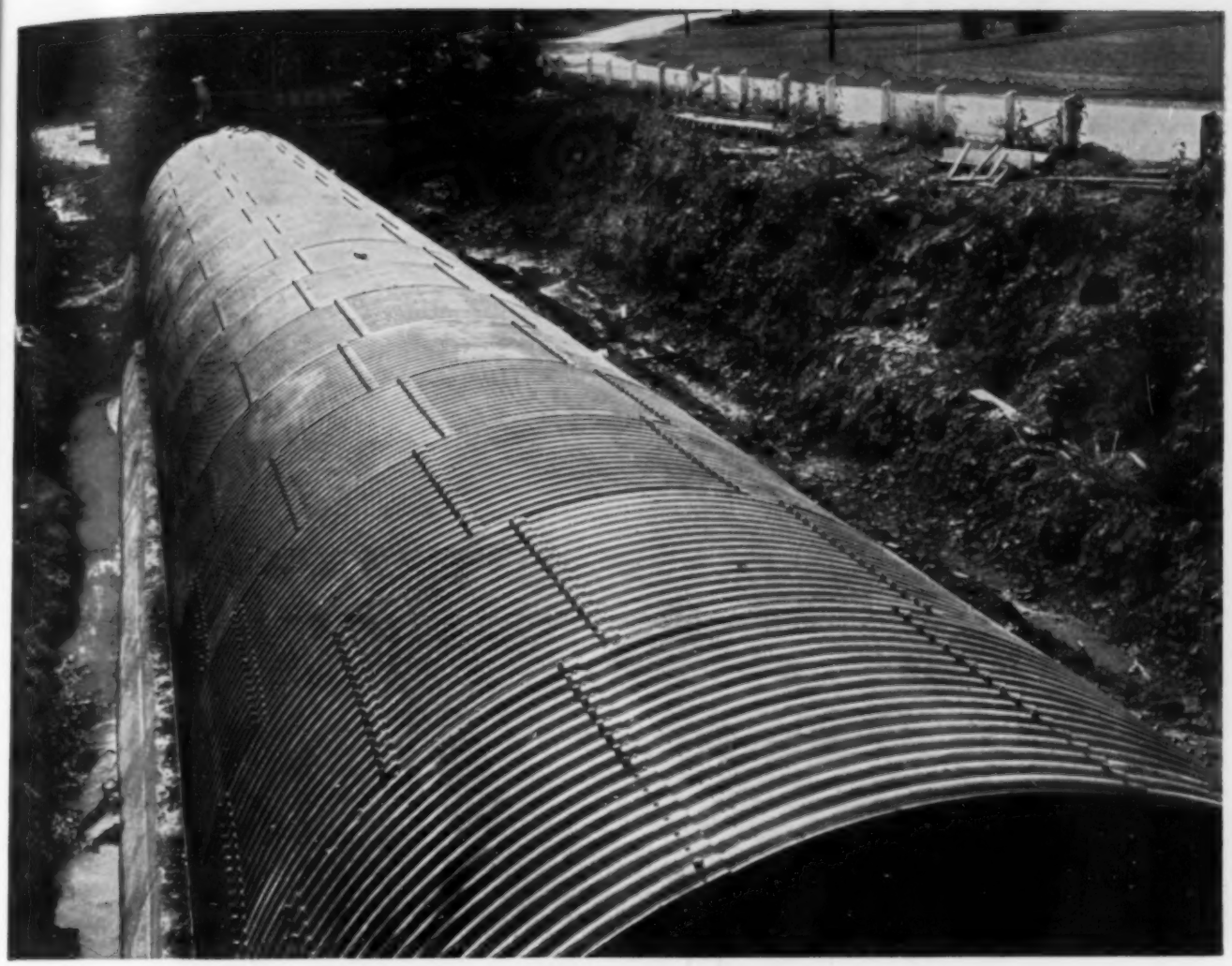
James Lester Brown (Assoc. M. '34) died in a hospital at Caney, Kans., on December 6, at the age of 44. At the time of his death Mr. Brown was employed as general superintendent for Mittry Brothers Construction Co., on a U.S. Engineer contract for the construction of Hulah Dam at Hulah, Okla. Active in the construction industry, Mr. Brown had worked for the Bureau of Reclamation and various contracting companies.

Oscar Frank Burbank (Assoc. M. '42) superintendent of the Hope Cemetery Department, Worcester, Mass., died on October 9, 1948, at the age of 69. From 1904 to 1918 Mr. Burbank was in the Office of the City Engineer of Worcester, Mass. As superintendent of Hope Cemetery from 1918 on, he designed and built a seven-mile roadway system, installed water and irrigation systems, and drained and reclaimed ten acres of bog waste. He had contributed numerous articles to cemetery and allied industrial publications.

Harry Day Chapman (Assoc. M. '08) of Richmond, Calif., died on December 4, at the age of 80. Early in his career Mr. Chapman was superintendent of construction for the Columbia Improvement Co. on dam and power-house construction. Later he served many years as city engineer and superintendent of streets of Richmond, Calif., and more recently as city engineer of El Cerrito, Calif.

Charles Francis Chenworth (Assoc. M. '40) lieutenant commander, U.S. Coast and Geodetic Survey, Norfolk, Va., died in the

(*Continued on page 88*)



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ARMCO DRAINAGE STRUCTURES

(*Continued from page 86*)

U.S. Marine Hospital there on November 19. He was 41. On the staff of the Survey since his graduation from Catholic University in 1930, Commander Chenworth had served on charting operations along the United States coast and in Alaskan waters during the war.

Henry Bernardin Drowne (M. '28) chief engineer of the Lane Construction Corp., of Meriden, Conn., died at his winter home in Lakeworth, Fla., on December 26. Mr. Drowne, who was 66, had been with the Lane organization since 1916. Earlier he had taught civil engineering at Brown and Columbia universities, and at one time was associated with Arthur H. Blanchard, consulting engineer in Providence and New York. He collaborated with Mr. Blanchard in the writing of engineering textbooks, and was author of several sections of the *American Highway Engineers Handbook*.

Edward Lloyd Walker (Assoc. M. '06) of Rutherford, N. J., died on December 11, at the age of 74. From 1931 until his retirement in 1946, Mr. Walker was senior hydraulic engineer for the New York State Public Service Commission in connection with public utility regulation. His earlier career had included work on the New York City water system and with the North Jersey District Water Supply System and eight years as assistant engineer for the Boston firm of Fay, Spofford & Thorndike.

Charles Curtis Hommon (Assoc. M. '28) sanitary engineer in charge of sewage treatment for the Canton, Ohio, Municipal Sewage Treatment Plant, Canton, Ohio, died on October 15, 1948. He was 59. From 1912 to 1917 and from 1920 to 1923, Mr. Hommon was superintendent of the Atlanta, Ga., municipal sewage-treatment plant. The period from 1917 to 1920 was spent as a captain in the Sanitary Corps of the Army, in charge of water supply and treatment. From 1924 to 1926 Mr. Hommon was assistant engineer in the Ohio State Department of Health, and since the latter date he had been in charge of the Canton municipal sewage treatment plant.

Raymond Freeman Goudey (M. '35) civil and sanitary engineer of Glendale, Calif., died suddenly on December 16, at the age of 54. A specialist in the sanitary engineering field, Mr. Goudey served in the Sanitary Corps of the Army in the first World War and later was with the California State Department of Public Health. From 1930 until recently he was sanitary engineer for the Los Angeles Department of Water and Power. He resigned a few months ago to open a private office and sanitary engineering laboratory in Glendale, where he was specializing in the treatment of water and sewage and industrial wastes. He has been active in the ASCE, and at the time of his death was serving on the executive committee of the Sanitary Engineering Division.

Raymond F. Goudey

Charles Enzian (M. '11) consulting engineer and geologist, with offices in Wilkes-Barre and Hazleton, Pa., died suddenly in Wilkes-Barre on December 7. A resident of suburban Kingston, Mr. Enzian had been associated with the anthracite and bituminous industries for 50 years. He was a pioneer in the field of mine safety and had done considerable research in mining for the government.

George Arthur Gregory (Assoc. M. '36) of Eatonville, Wash., died on September 3 at the age of 54. Mr. Gregory had been resident engineer on the construction of Cushman Dam No. 2 and its appurtenances; project engineer on the construction of the Lake Washington floating bridge and the Tacoma Narrows Bridge; and chief resident engineer on the City of Seattle's Skagit Hydroelectric Development. More recently he had been abroad as construction engineer for the National Hydroelectric Engineering Bureau of the National Resources Commission of China.

Charles Jacob Hyer (Assoc. M. '15) president of the Tampa Marine Co., Tampa, Fla., died on December 11. Mr. Jacob, who was 62, had been president of the Tampa Marine Co. since 1929. Prior to that he was chief engineer of the Tampa Dock Co., and at one time was a partner in the Tampa engineering and contracting firm of McGucken & Hyer.

Clarence Richard Knowles (M. '24) retired engineer of Chicago, Ill., died on August 6, 1948. Mr. Knowles, who was 69, spent his career with the Illinois Central Railroad. From 1916 until his retirement a few years ago he was superintendent of the water service for the system.

Oren Elisha Parks (M. '05) retired engineer of Westfield, Mass., died on July 4, 1947, according to information just received at Society headquarters. Mr. Parks, who was 76, had spent practically his entire career as town engineer and engineer of the Westfield Water Works. At one time, also, he was general manager of the Woronco Constr. Co., and more recently he was superintendent of the Westfield Board of Public Works.

William Francis Stanton Root (Assoc. M. '19) retired engineer of Mount Vernon, N.Y., died on August 28, 1948, according to word just received at Society headquarters. His age was 73. Mr. Root spent his early career in railroad work, and during the first World War served overseas as a captain in the Army Corps of Engineers, commanding the 102nd Engineer train. From 1923 to 1933 he was resident engineer for the Westchester County (New York) Park Commission, and later served in an administrative capacity with the Works Progress Administration on a number of construction projects in the metropolitan area.

Samuel Payson Waldron (M. '09) of Needham, Mass., died some time ago, although word was just received at Society headquarters. He was 75. From 1901 until his retirement in 1937 Mr. Waldron was in the engineering and contracting departments of the American Bridge Co., serving for a number of years as contracting manager of the Boston office.

Frank Henry Mason (M. '21) chief engineer of the New England Public Service Co., Augusta, Me., for more than 40 years, died in a hospital in that city on December 17. He was 69. During his long tenure as chief engineer of the public utilities group, Mr. Mason was in charge of the construction of such projects as Wyman Dam at Bingham, the Gulf Island Dam at Lewiston, the Long Falls Storage Reservoir at Dead River now under construction, and of more than 30 power stations throughout northern New England. He had been active in the Northeastern Section of the Society, the Boston Society of Civil Engineers, and the Maine Association of Engineers, and was a past-president of the latter organization. He had also served on the first state board of registration for professional engineers.

Frank H. Mason

Mason Delano Pratt (M. '01) of New Canaan, Conn., died in October 1947, though the Society had just been notified of his death. He was 82. In 1918, after experience in street railway and railroad engineering work in the East, Mr. Pratt went to San Francisco where he established a general consulting practice. He specialized in adjusting contract losses for sureties, completing contracts, and other surety contract claims work. He retired several years ago.

Joseph Ogier Whittemore (M. '12) of Miami, Fla., died on October 20, 1948. Mr. Whittemore, who was 78, had served as resident engineer in charge of construction of the North German Lloyd Steamship terminal at Hoboken and of piers and other waterfront developments. He was assistant engineer in charge of the design and construction of reservoirs for the New Rochelle, N. Y., Water Co., and for a number of years was city engineer of Hoboken, N. J.

James Zaloudek (Assoc. M. '38) of Chicago, Ill., died on December 9, at the age of 45. Mr. Zaloudek had built mills for F. W. Stock & Sons at Hillsdale, Mich., and for the Krause Milling Co., at Milwaukee, Wis. More recently he had been structural engineer for the Chicago Rapid Transit Co., and the Weitz Co., Inc., at Des Moines, Iowa.

Construction Engineer Builds Organization

(*Continued from page 30*)

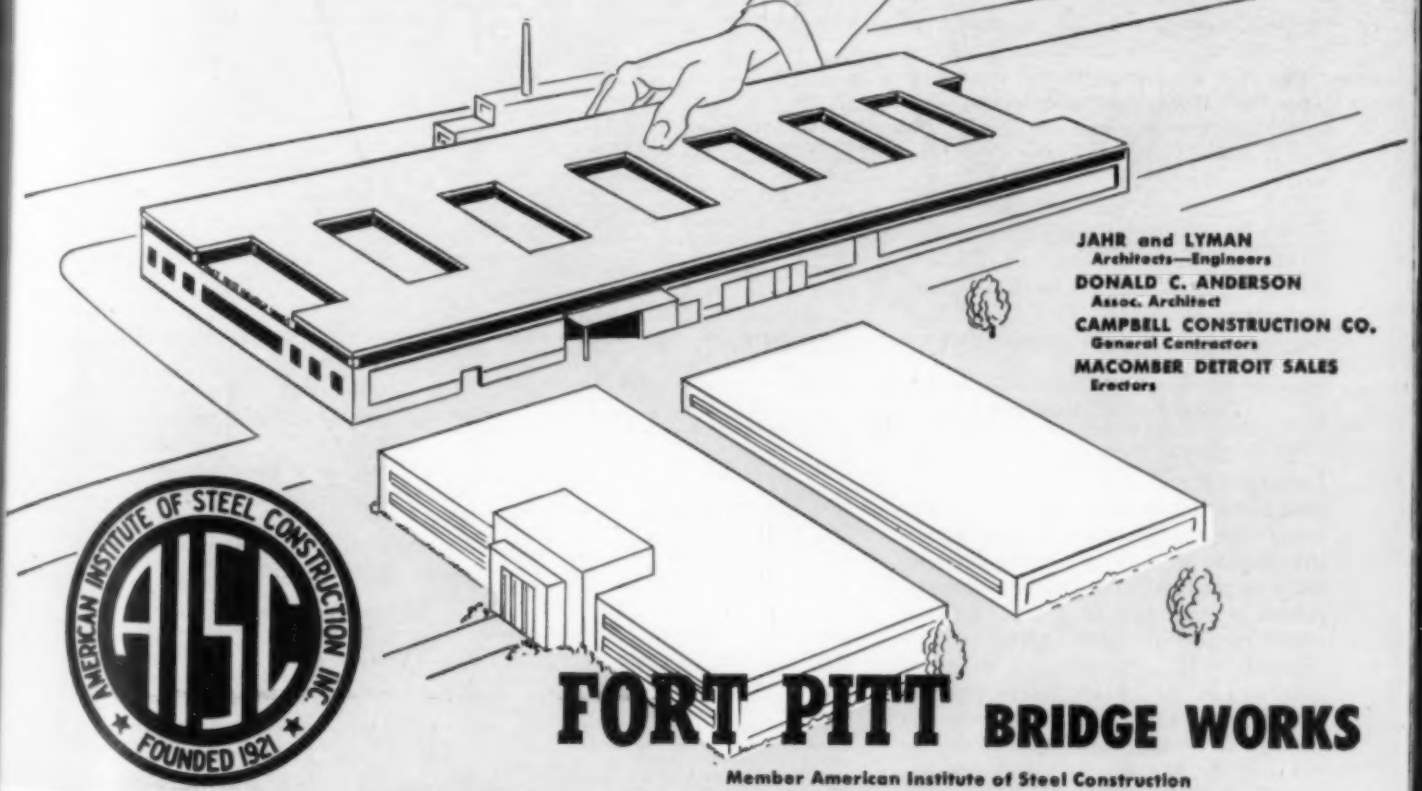
the foundation for the dam as finally built and place about the same amount of concrete for the foundations of a higher dam—the present structure. Later a second contract provided for the completion of the dam and powerhouse. An accompanying photograph shows the work completed under the first contract.

The administration of contract construction has many exciting mo-

(*Continued on page 90*)

FORT PITT BRIDGE meets an "IMPOSSIBLE SCHEDULE"

Let's look at this "impossible schedule"—ground was broken for the main building, covering nearly four acres on February 13, 1948—and it *was ready for occupancy* on July 26, 1948. This record-shattering construction achievement for the Harry Ferguson, Inc. Tractor Assembly Plant and Power House—for which Fort Pitt Bridge supplied the Structural Steel—is proof of the importance of progressive architectural planning, modern engineering "know-how," owner's foresight, contractor's ability to produce and *suppliers' integrity.*



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"STEEL PERMITS STREAMLINING CONSTRUCTION WITH SAFETY, ENDURANCE AND ECONOMY"

(*Continued from page 88*)

ments. One which the writer will never forget is when Henry Kaiser, president of the Six Companies, contractors on Hoover Dam, after long negotiation agreed to the Order of Changes which settled the Hoover Dam contract except for miscellaneous small items amounting to some $35,000 out of the total contract of some $120 million. Mr. Kaiser finally dropped these minor claims on the writer's desk and said he would, for his corporation, accept any part of them which the writer thought appropriate (about $7,000), thus bringing to a satisfactory conclusion this five-year contract in the desert.

Based on his experience with the Bureau of Reclamation over a period of many years, it is the writer's firm belief that all major construction jobs should be performed by contract methods.

Why Bridges Fail in Floods

(*Continued from page 42*)

model pier. Sand on the bed away from the pier was in motion—sliding along the bed—but not in suspension in any appreciable amount. This bed was smooth without ripples or waves. The vortex around the pier picked up sand rapidly, and the shape of the scour hole seemed to be the result of sand sliding down at the angle of repose toward a low point not far away from the pier. There seemed to be a second vortex near the water surface, but it was in the opposite direction and carried no sand.

It is of interest to note that if the glass graduate is assumed to represent a tubular bridge pier 6 ft in diameter, the water depth of this particular experiment represents about 4½ ft, and the depth of scour below the stream bed, 6¼ ft.

Further Tests Contemplated

The Rocky Mountain Hydraulic Laboratory expects to continue erosion tests during the summer of 1949, using the method here described to investigate as wide a range of conditions as possible, and if sufficient manpower is available, to include several more practical pier types. The laboratory is a cooperative venture, and a number of engineers participated in planning and executing the preliminary tests described here, including Mr. Matthes, E. W. Lane, M. ASCE, Prof. R. W. Powell, M. ASCE, and Wen Shao Wang, as well as the writer.

FIELD ENGINEERING. 22 ed., 1949. 414 pp., diagrs., 7×4 in., cloth, Volume I (text), $3.75; 422 pp., Volume II (tables), $3.75, and combined Volumes I and II, $6.50. Philip Kissam, M. ASCE, professor of civil engineering at Princeton University, has thoroughly revised the famous route engineering reference book by the late William H. Searles and the late Howard Chapin Ives, first published in 1880. New material added includes a discussion of the methods and advantages of air mapping, the complete theory and application of the vertical curve, basic economic aspects for highway and railway location, the latest surveying techniques, the two-base method for precise altimetry, and many other topics not contained in the former edition. The author has also modernized the older subject matter on the various types of curves, earthwork calculation, construction, and track laying.

FLOODS, THEIR HYDROLOGY AND CONTROL. By H. K. Barrows. McGraw-Hill Book Co., New York, Toronto, London, 1948. 432 pp., illus., charts, maps, tables, 9¼×6 in., cloth, $6.50. This book considers the basic features of flood hydrology and their application to the problems relating to control projects. Somewhat detailed descriptions are given of the more important great floods and their resulting damage in the United States. In addition to the analysis of the use of reservoirs for flood control, the features of local flood-protection work are discussed. A group of typical problems relating to flood-control projects is appended.

GEOGRAPHICAL DISTRIBUTION OF ENGINEERING RESEARCH AND RELATED INDUSTRIES IN THE UNITED STATES. (Technical Publication No. 481). By H. M. Conway, Jr. Southeastern Research Institute, 5009 Peachtree Road, Atlanta, Ga., 1948. No pagination, diagrs., charts, maps, tables, 11×8½ in., paper, $2. Surveying the research establishments of the nation, this volume affords a basis of comparison of engineering research and development activity in various sections of the country. It appraises the present distribution of activity, analyzes the causes, and suggests means by which undesirable conditions can be minimized in the future.

MATHEMATICAL SOLUTION OF ENGINEERING PROBLEMS. By M. G. Salvadori with a collection of problems by K. S. Miller. McGraw-Hill Book Co., New York, Toronto, London, 1948. 245 pp., diagrs., charts, tables, 9¼×6 in., cloth, $3.50. This book aims at widening the mathematical background of the student and at filling the gap between theoretical mathematics and the technique of solving physical problems. The six chapters deal with: Fundamental ideas of mathematics, use of plane Cartesian geometry, solution of algebraic and transcendental equations, solution of systems of simultaneous linear equations, elementary functions of a real and complex variable, and the Fourier series. Illustrative problems are taken from elementary physics and mechanics and from the various branches of engineering.

PHYSICAL GEOLOGY. 3 ed. By C. R. Longwell, A. Knopf and R. F. Flint. John Wiley & Sons, New York; Chapman & Hall, London, 1948. 602 pp., illus., maps, charts, tables, 9¼×6 in., cloth, $5. The third edition of this standard textbook has been rewritten with added material to bring it up to date. Beginning with a general treatment of the method and scope of geologic study, the book covers all the major aspects of the field with emphasis on the basic concepts. The final chapter discusses the relation of numerical resources to geology. As before, the lists of properties and characteristics of minerals and rocks are collected in an appendix.

PLASTICITY AS A FACTOR IN THE DESIGN OF DENSE BITUMINOUS ROAD CARPETS. By L. W. Nijboer. Elsevier Publishing Co., Inc., New York, Amsterdam, London, and Brussels, 1948. 184 pp., illus., diagrs., charts, tables, 9¼×6¼ in., cloth, $5.25. The importance of a thorough knowledge of the mechanical properties of bituminous road materials is pointed out in this volume by a Dutch engineer, and a study is made of the plastic properties of such materials. After discussing existing test methods, the author develops a new method on the principles of soil mechanics. Theoretical and practical studies of bearing capacity and compaction by rolling are also included.

PRESTRESSED CONCRETE. By Gustave Magnel. Concrete Publications, Ltd., 14 Dartmouth St., Westminster, S.W.1, London, 1948. 215 pp., illus., diagrs., charts, tables, 9¼×6½ in., cloth, 15s. A concise account of present knowledge on the subject of prestressed concrete is presented in this book, which provides data for the design of some types of structures, and information of value to contractors on proper erection of work. Chapters contain material on statically-determinate beams, continuous beams with equal spans, and several discussions of principles of prestressing.

SEMI-FIREPROOF CONSTRUCTION. By H. R. Staley D. Van Nostrand Co., Toronto, New York, London, 1948. 327 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $6. This book deals with the details of construction and the sequence and methods of erection of buildings within the scope of semi-fireproof construction. A discussion of soils and piling foundations is presented. The assembly of forms for walls and the mixing, handling, and placing of concrete for both walls and floors are discussed in detail. Exterior masonry wall construction is dealt with both from the point of structural integrity and watertightness. Tools and equipment are discussed as each operation is considered.

SIMPLIFIED DESIGN OF STRUCTURAL TIMBER. By H. Parker. John Wiley & Sons, New York; Chapman & Hall, London, 1948. 218 pp., diagrs., charts, tables, 8×5 in., leather, $3.25. Of value to builders and architects, this book can also be used by those with no previous training or study. Dealing primarily with wood members that support loads in buildings, the book includes a full explanation of the principle of mechanics involved in the design of these members which is based on the recommendations of leading authorities of timber construction. There are 45 useful tables as well as practical examples and problems.

SPECIFICATIONS AND LAW ON ENGINEERING WORKS. By W. C. Sadler. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1948. 493 pp., tables, 8½×5½ in., cloth, $5. Designed for the engineer with little or no legal training, this book provides a foundation in engineering law for the writing of specifications. A summary of the historical significance of various legal systems is included. Among the topics specifically discussed with examples taken from actual experience are the legal instruments of contractural documents, illegal matters of concern to engineers, the law on agency partnerships and corporations, patents, and workmen's compensation. A complete set of detailed contracts and specifications, covering the construction of a transmitter building for the University of Michigan, is presented in the appendix.

STANDARD DESIGN OF REINFORCED CONCRETE ROAD BRIDGES. By L. E. Hunter with a foreword by R. S. Murt. Chapman & Hall, Ltd., London, 1947. 174 pp., diagrs., charts, tables, 9×6 in., cloth, 25s. Of interest to the civil engineer who has to deal with highway bridge problems, this book gives complete design information. It contains many useful tables for the rapid design of fixed arches, slabs, beams, and culverts. Necessary essential mathematical analysis is included. A special chapter considers steel girder bridges.

THE FAILURE OF METALS BY FATIGUE. Melbourne University Press, Melbourne, Australia, 1947. 505 pp., illus., diagrs., charts, tables, 9¾×5½ in., cloth, £2.2.0. Engineers concerned with the design, development, or maintenance of machine structures, and components subjected to cyclic stresses will be interested in this volume which details the proceedings of a symposium held in the University of Melbourne.

THE THIRSTY LAND. By Robert de Roos. Stanford University Press, Stanford, Calif., 1948. 265 pp., illus., 9¼×6¼ in., cloth, $4. This volume gives a graphic picture of the Central Valley Project of California which, when completed, will include 40 dams and reservoirs, 28 hydroelectric plants, and 11 main canals. Problems caused by local and government controversies are discussed in several chapters.

Federal Aid Called Insurance in Fight on Pollution

(*Continued from page 25*)

Ostertag, who warned that unless anti-pollution measures are taken at once, safe, clean waters will become only a memory in New York State.

Assemblyman Ostertag, chairman of the Joint Legislative Committee on Interstate Cooperation, which is sponsoring pollution abatement legislation in this session of the New York State Legislature, was one of the principal speakers before the annual meeting of the New York State Sewage Works Association held on January 21 in conjunction with the Sanitary Engineering Division of ASCE and the American Water Works Association. His topic was "Safe, Clean Waters for New York State—a Hope or a Memory."

More than a billion gallons of filth flow untreated into New York's water-courses every 24 hours, Assemblyman Ostertag asserted. This staggering burden consists of raw sewage from 115 municipalities with a population of 4,726,000 plus corrosive or putrid wastes from thousands of industries. In addition, 424 communities of 500 to 1,000 or more lack sewers and sanitary disposal systems and add to the contamination of surface waters through seepage or direct discharge of wastes.

While many communities, industries and individuals have assumed the costs of waste treatment, in the interest of the general welfare, Assemblyman Ostertag pointed out that the task of restoring and maintaining New York's waters in a state of safe usefulness is one that must be assumed by everyone.

"Pollution abatement," he said," is either everybody's job or nobody's job. It is neither fair nor possible for some of our communities and industries to clean up the filth created by all of them.

"Increasingly the public is demanding that the destruction of our waters for domestic, recreational and industrial uses be stopped. Unless we take steps now to check and eliminate the burden of pollution that threatens our waters, New York State will have lost its greatest basic resource."

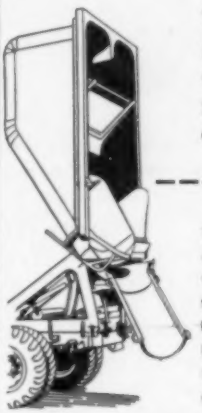
Higher Fares Suggested for On-Time Landings

(*Continued from page 26*)

Warning that each airport terminal is a study in itself, Mr. Sullivan cautioned that "application of stock layout or plans that have satisfied re-

(*Continued on page 92*)

That's a lot of concrete. And the Dumpcrete placed it faster and cheaper. Mass pours for U. S. Engineers, Atomic Energy Commission and Bureau of Reclamation—small, slow pours into buggies and wheelbarrows—city and state paving work—footings and floors for industrial and housing projects. You name it. The Dumpcrete's done it . . . with identical loads of better concrete, accurately mixed at a central point. The low-cost, high production Dumpcrete can save for you too. Mail the coupon today.



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(*Continued from page 91*)

quirements of other airports is inviting trouble."

John M. Kyle

Experience at various airfields in the United States and in other areas in the world has indicated that it is possible to operate a field inside a dike, at an elevation even lower than the adjacent waters with perfect safety, provided the glide paths to the runways are adequately protected, Mr. Kyle asserted in his paper.

"The solution arrived at was the installation of an earth dike around the perimeter of the low areas of LaGuardia Airport where the maximum settlement had occurred," he said, "this dike to be stabilized in such a manner that the erosion from the adjacent waters would not materially affect its integrity. In order to insure that this dike would not develop mud waves and itself be swept into the bay, particularly where the underlying mud was the deepest and the least stable, sand drains were installed in the area to be occupied by the dike before placing the dike fill.

"To provide for the field drainage, for the removal of rain water and for the removal of water seeping through the dike, a ditch will be installed inside the dike proper. A 36-in. runoff pipe with a gravity-actuated tide gate has been installed connecting the ditch to the bay. By draining the ditch at non-high-tide periods this pipe will be sufficient for the normal flow due to seepage and collection of surplus water at periods other than those of maximum rainfall. Sumps and pumps in the ditch will be provided to take care of drainage during abnormal high tides and periods of excessive rainfall.

"The entire operation to date has been conducted in such a manner that the field has been operable at all times. Because of the proximity of good fill on adjacent Port Authority property and by means of the simple expedient of erecting an earthfill dike on a sand-drain stabilized foundation, it has been possible to protect this vital air terminal as a continuously operable field at a very low cost."

J. C. Evans

In an area of such magnitude as that covered by the Port of New York District—an area of 1,500 sq miles containing approximately 13 million inhabitants, or about 9 percent of the population of the continental United States—it is unreasonable, Mr. Evans said, "to expect the continuance of present practices which require officials at separate piers and separate airports to process customs, immigration and other requirements of the Federal Government. This division of federal personnel should not be further amplified by having each airport equipped to handle international trade. Therefore a segregation should be made in the interest of the international traveler and the Federal Government so that an experienced personnel can be located at one airport, 'the point of entry,' to process all international traffic methodically and expeditiously.

"All recognize that air transportation, like other media of transportation, is subject to weather conditions and, this being so, requires personnel on a 24-hour basis to cope with such exigencies. It is believed that one 'point of entry by air' should be established for international passengers and that the other airports should serve primarily as terminals for intranational airport transportation.

"Multiple airports being necessary in a metropolitan area like the Port District, some reasonable preclassification as to terminals and routes must be established so that air travelers can lessen the time of ground transportation as a part of the elapsed time from home or office to destination."

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New Publications

(*Continued from page 82*)

Power Resources. Results of a comprehensive investigation of power supply and demand in New England are summarized in a recent report of the Power Survey Committee of the New England Council, entitled *Power in New England*. In addition to examining the existing power situation, the present study forecasts the probable growth of power demand over the next decade and indicates the need for an increase in New England's generating capacity of about 1,000,000 kw during the same period. William F. Uhl, M. ASCE, president of Charles T. Main, Inc., of Boston, and his staff prepared the report, with the assistance of Harold K. Barrows and Howard Turner, Members ASCE. Copies of the report are available at $1 each from the New England Council, Statler Building, Boston 16, Mass.

Steel Construction. Rules for the use of steel, formulated in September 1947 for the work of the French Ministry of Reconstruction, Urbanization, and Private Works, are discussed in a recent bulletin, *Commentaires des Regles d'Utilisation de l'Acier Applicables aux Travaux du Ministere de la Reconstruction et de l'Urbanisme et aux Travaux Prives*. Copies may be obtained from the Institut Technique du Batiment et des Travaux Publics, 28, Boulevard Raspail, Paris VII for 300 francs in paper binding and 330 francs in boards, plus 25 francs for postage.

The discovery of harmful organisms and disease germs in your water supply is something to get excited about . . . destroy them by hypochlorination with %Proportioneers% Heavy Duty Chem-O-Feeder — the modern way to protect the health of your community. There's no risk of dangerous undertreatment or the disagreeable taste resulting from wasteful overtreatment. By simply turning a knob, the chemical feeding rate may be instantly adjusted while the pump is operating . . . up to 7 g.p.h. can be fed with extreme precision.

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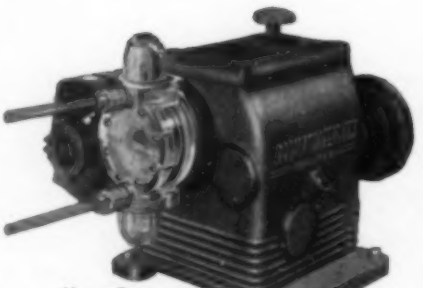

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Engineering Education. To aid young men who are considering professional careers in engineering, chemistry, or the physical sciences, the Polytechnic Institute of Brooklyn has issued a 68-page handsomely illustrated brochure, entitled *Careers in Engineering and Science*. Inquiries should be addressed to the Committee on Admissions, Brooklyn Polytechnic Institute, Brooklyn, N.Y.

Engineering Research. In its Annual Report for 1948, the Midwest Research Institute, Kansas City, Mo., details its history of research service since its formation in 1943 and outlines its current program and facilities.

Highway Research. Continuing its survey and analysis of state highway needs, the Automotive Safety Foundation has prepared detailed reports for Kansas, Nebraska, and Oregon on their current highway situation, with recommendations for future improvement and development. The reports are entitled *Highway Needs of Kansas*, *Nebraska Highway Needs*, and *Highway Transportation System in Oregon*. G. Donald Kennedy, M. ASCE, headed the ASF engineering staff loaned to the states for making the surveys.

Construction Materials. Field and laboratory data on the geologic materials in Phillips County, Kansas, of use to engineers for construction purposes—compiled in a joint survey made by the U.S. Geological Survey and the Kansas State Highway Commission—have been assembled in Department of the Interior Circular 21. Inquiries concerning the report, which is entitled *Construction Materials in Phillips County, Kansas*, should be addressed to the Department of Commerce, Washington 25, D.C.

Highway Research. Results of a cooperative study of pumping of concrete—made by the State of Illinois, Division of Highways, and the Portland Cement Association and presented at the 27th annual meeting of the Highway Research Board—are now made available by the Highway Research Board in its Research Report, No. 1 D, *A Survey of Pumping of Concrete Pavements in Illinois*. The report may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Engineering Education. Several papers presented before the Civil Engineering Division of the American Society for Engineering Education at its 56th annual meeting in Austin, Tex., have been reprinted in the December 1948 *Civil Engineering Bulletin* of the ASEE. Authors include William T. Ingram, Assoc. M. ASCE, engineering field associate for the American Public Health Association, and Alfred L. Miller, M. ASCE, professor of mechanics and structures at the University of Washington.

Highway Research. Computation of traffic stresses in a simple road structure is discussed in Road Research Technical Paper No. 9 of the British Department of Scientific and Industrial Research. The paper, which details current experiments on road pavement design being made in the

(*Continued on page 95*)

(Continued from page 94)

National Physical Laboratory, may be obtained by mail from His Majesty's Stationery Office, London, at a cost of 10d (25 cents).

Engineering, Turkey. Current developments in Turkish technical and industrial fields will be reported in *Teknik Dergi*, a new technical periodical being published by a staff of technicians in Istanbul, Turkey.

Hydraulic Research. Issuance of Technical Memoranda No. 2-262 and 2-263, describing model investigations conducted at the Waterways Experiment Station, has been announced by the Army Corps of Engineers. The first of these is on the irrigation tunnel for St. Mary Dam at Alberta, Canada, and the other deals with spillway design for Whitney Dam on the Brazos River in Texas. Both sell for $1, and may be purchased from the Waterways Experiment Station at Vicksburg, Miss.

Wire Rope. To celebrate the completion of 50 years of wire-rope making at its Palmer, Mass., plant, the Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corp. has issued an anniversary volume that summarizes the history and manufacture of wire rope. Inquires should be sent to the Colorado Fuel and Iron Corp., Wickwire Spencer Steel Division, Palmer, Mass.

Small House Construction. A practical program for the small house builder is presented in *Small House Carpentry* by Lee Frankl. Explaining basic aspects of the "industry engineered" house project, sponsored by the Producers' Council and the National Retail Lumber Dealers Association, the publication gives full instructions for framing, sheathing, and insulation, and describes proved techniques for time and labor saving and organizing and coordinating the work with a view to obtaining maximum economy. Prentice-Hall, 70 Fifth Avenue, New York 11, is publisher of the volume, which sells for $2.95.

City Planning. A long-term plan for the improvement of St. Louis streets over a period of at least 25 years is outlined in *Major Streets 1948*, first of a series of detailed reports to be prepared by the St. Louis City Plan Commission. Requests for the report should be sent to the City Plan Commission, St. Louis, Mo. ASCE members on the Commission include Albert H. Baum, Jr., and Harland Bartholomew.

Concrete Standards. Current standards of the American Concrete Institute (except "Manual of Standard Practice for Detailing Reinforced Concrete Structures," which because of its large format is available only as a special publication) have been reprinted from the ACI Journal under the title of *ACI Standards—1948*. The publication may be purchased from the ACI, New Center Building, Detroit 2, Mich., at a cost of $2 ($1.25 to ACI members).

Grade-Crossing Elimination. Progress made by New York City in its program of grade-crossing elimination is summarized in a recent brochure graphically illustrated with before-and-after photographs. The pamphlet, entitled *Completion of New York City's Railroad Grade Crossing Elimination Program*, is obtainable without charge from

(Continued on page 97)

The third of a series in the interest of more efficient use of steel... a vital American resource.

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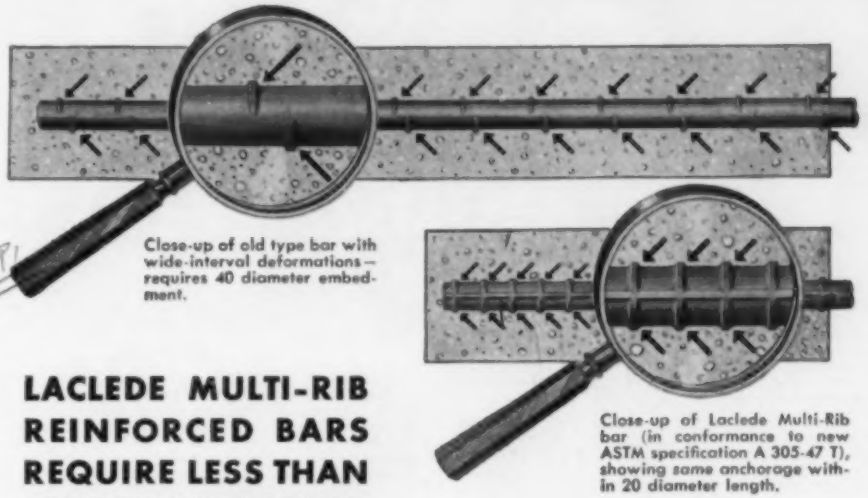

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Positions Available

STRUCTURAL DESIGN-DRAFTSMAN, mechanical graduate, 35–45, with at least 10 years' experience in structural and equipment design, to design and detail mining structures and machinery installations. Salary, $7,000–$8,000 a year. Location, eastern Pennsylvania. Y-1514.

CONSTRUCTION SUPERINTENDENT with housing experience, to supervise erection of precast concrete slab houses. Must have had experience in South America and be able to speak Spanish. Salary open. Location, Venezuela. Y-1546.

CONSTRUCTION ENGINEER, with process plant, terminal, industrial and housing experience, for field and office engineering duties with general contractor. Salary, $7,500 a year, plus maintenance. Location, Venezuela. Y-1607.

TEACHING PERSONNEL. (*a*) Instructor, recent graduates, civil, electrical or mechanical, to teach drawing and descriptive geometry. Opportunity to continue studies for master's degree (*b*) Assistant Professor, graduate, master's degree and some teaching experience to teach the above subjects. Location, Michigan. Y-1683D.

ASSISTANT PROFESSOR, 25–40, graduate civil engineer, preferably with advanced degree, and with 3 to 5 years' experience in structural work, to teach structural engineering. Salary, $3,600–$4,500 a year. Location, Delaware. Y-1917.

ASSOCIATE PROFESSOR, with at least a master's degree and experience, for civil engineering or mechanics department. Location, Upstate New York. Y-1937.

ENGINEERS. (*a*) Laboratory Assistants with several years experience in testing laboratory of state highway department or general commercial testing of construction materials. (*b*) Engineering Inspectors, young, with timber, asphalt, soils, concrete, etc., testing and inspection experience. Some traveling. (*c*) Laboratory Supervisor with at least 5 years' experience covering cement, concrete, soils, asphalts and other construction materials, to take charge of laboratory analyses, records, reports, etc. Location, New Jersey. Y-1948.

CONSTRUCTION SUPERINTENDENT experienced in both building and heavy construction work. Must have good record with reputable contractors. Immediate job is one of about three years' duration, located in the Great Lakes Area, but position will be permanent for right man. Headquarters, New York Metropolitan Area. Y-1953.

ASSISTANT TECHNICAL EDITOR with good basic training in civil engineering, some literary aptitude and, preferably, a few years practical engineering experience. Salary, open. Location East. Y-1956.

TEACHING PERSONNEL. (*a*) Civil Engineer, preferably with teaching experience. Should be capable of and interested in laboratory work, particularly for hydraulics. (*b*) Civil Engineer interested in field work, surveying, highways, railways, etc. Appointments made for a term of three years. Round-trip travel provided if contract is completed and single instructors receive full maintenance. Location, Turkey. Y-1959.

DESIGN SUPERVISOR, under 50, mechanical or civil graduate, with at least 10 years' supervisory and project experience covering design and layout of mechanical trades in construction industry, preferably in New York and Eastern seaboard to take charge of sanitary, heating, etc., for consulting firm. Salary, $6,000–$7,000 a year. Y-1961.

STRUCTURAL STEEL AND REINFORCED CONCRETE DESIGNER with consulting experience, some structural steel detailing, construction inspection for registered architectural-engineering firm. Graduate engineer. Power plant experience and/or steel mill design experience. Minimum of 10 years' experience. Salary, $6,000–$7,200 a year. Location, Pennsylvania. Y-1971(*a*).

JUNIOR ASSOCIATE PLANNER, 25–54, graduate with an engineering or architectural degree or registered as a professional engineer or architect in the State of Maryland; with 4 years' experience in city planning, engineering or architectural work, one year of which must have been in responsible charge; graduate work related to urban or regional planning problems may be substituted. Will be responsible for technical studies and analysis. Some design work will be required, but major emphasis will be on the preparation and analysis of economic studies, estimates and financing plans. Appointment will be temporary, subject to civil service examination at a later date. Salary, $4,200–$4,900 a year. Location, Maryland. Y-1980.

ENGINEERS for projects, including steam-electric power plants, hydro-developments, industrial buildings, wharves, wind- and fluid-testing tunnels, atomic energy, etc. (*a*) Architects, Architectural Designers and Architectural Draftsmen, preferably graduates. Experience essential. (*b*) Structural Engineers, Designers, and Draftsmen, graduates, with some practical experience. Salary dependent upon experience. Location, Massachusetts. Y-1993.

BRIDGE ENGINEER, experienced in design of steel highway bridges. Must be qualified to design and detail plate girder and truss spans and floor systems; 2 or 3 years' work. Salary, $9,000 a year. Location, Alaska. Y-2002.

STRUCTURAL ENGINEER. Must be capable of completely designing small steel structures. Prefer civil engineering graduate, experienced in both design and fabrication. Excellent opportunity with well established firm in Missouri. Y-2015C.

CHIEF ENGINEER, civil, for manufacturing plant (prefabricated houses) in Philadelphia area. Architectural background desirable, but not essential. State age, experience and salary desired. Y-2016.

SANITARY AND HYDRAULIC ENGINEER experienced in the design and operation of water works, sewage, and industrial waste treatment plants for consultant's office. Permanent position for a competent designer. State qualifications, experience, age, starting salary, and date available. D-4665.

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(Continued from page 95)

the Office of the City Construction Coordinator, Randall's Island, New York 35, N.Y.

Traffic Control. Results of a combined parking survey and origin-and-destination studies—made by the Louisiana Department of Highways in cooperation with the Public Roads Administration and local government agencies—are outlined in a Louisiana Department of Highways illustrated release, entitled *Monroe Traffic Survey*. Inquiries should be addressed to the Department, Baton Rouge 4, La.

Corrosion. Two publications on corrosion have recently been made available for sale by the National Association of Corrosion Engineers, 905 Southern Standard Building, Houston 2, Tex. These are a 129-page *Bibliographic Survey of Corrosion*, by Robert D. Misch, James T. Waber, and Hugh J. McDonald, of the Corrosion Research Laboratory of the Illinois Institute of Technology, which sells for $5 ($4 to members of NACE); and *Directory of the American Coordinating Committee on Corrosion*, priced at $2 a copy.

Water Resources. Cooperative studies of the water resources of Montgomery County, Ohio, made by the Ohio Water Resources Board and the U.S. Geological Survey, are summarized in Bulletin No. 12, a recent publication of the Board. Copies of the report, which is intended as a guide for the development of farm, public, and industrial water supplies in the area, may be obtained fron the Ohio Water Resources Board, 553 East Broad Street, Columbus 15, Ohio.

Highway Studies. To arouse interest in the Virginia highway program, the Department of Highways has compiled a 51-page report on its construction and maintenance operations for distribution in the high schools of the state. The booklet, entitled *Toward a Greater Virginia*, is presented in a simple, informative style, with many illustrations. A limited number of copies is available for free distribution, on request to the Department of Highways, Commonwealth of Virginia, Richmond, Va.

Housing Materials. Properties affecting the serviceability of wood are discussed in *Manual on Wood Construction for Prefabricated Houses*, a recent publication of the Housing and Home Finance Agency. Though the 330-page manual includes special information for use by prefabricators, most of it is applicable to all types of wood construction. The manual is available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at a cost of $1.50.

Highway Safety. The nation's program for increasing safety on streets and highways is summarized in a 76-page report of the President's Highway Safety Conference, entitled *Inventory and Guide for Action*. Copies of the report, which was prepared by the staff of the President's Highway Safety Conference and adopted by the Committee on Conference Reports, is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 65 cents each.

Viber Company has long recognized the destructiveness of steel vibrators on many popular form lining materials.

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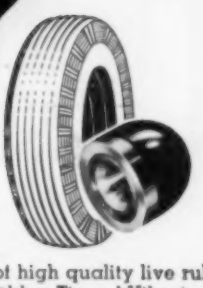

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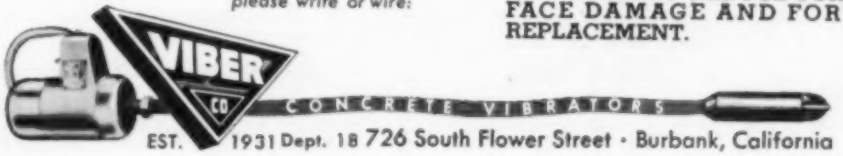

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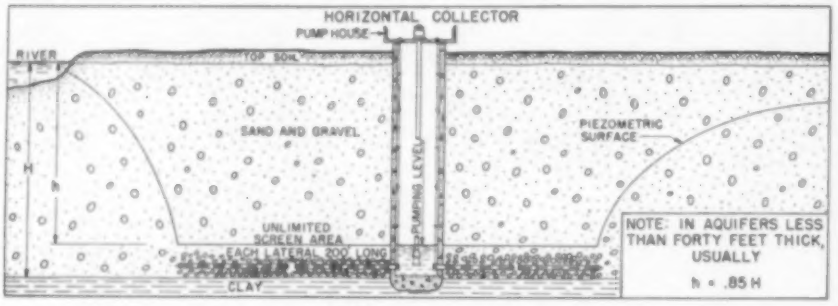

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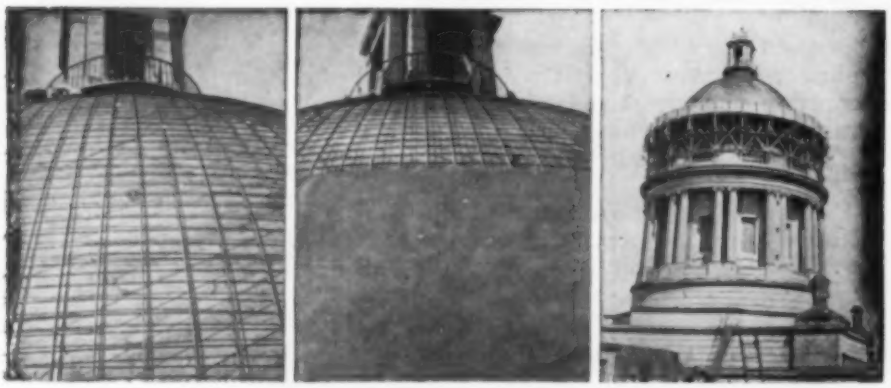

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The photos show the 48' diameter dome of the Kentucky State Capitol at Frankfort. This dome was originally wood construction which deteriorated and necessitated replacement. The new dome was constructed of 3" reinforced "GUNITE" by this organization.

"GUNITE" provides the structural dome and is covered with decorative glazed tile. We did this work in 1941 under the supervision of Roberts and Schaefer, Architects.

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Double-Deck Underpass Rebuilt Without Delaying Trains

(*Continued from page 41*)

The principal problem in the superstructure work is the temporary support of the undisturbed structure during installation of the new girders and deck. Here train operations are suspended on only one track at a time, and for a period not to exceed 30 days per track. Before taking down one track, the adjacent track is shored on timbers capped with steel, wedged up under the floor beams.

Shoring to support the structure for the upper four tracks extends up between the tracks of the lower level. For the lower tracks, the shoring is placed initially under the track second from the edge of the trestle, and is moved back one track at a time as erection of each preceding track is completed. Vehicular traffic on Van Wyck Boulevard has been crowded toward the undisturbed west abutment in order to provide working area. At all times during the work two-way traffic has been maintained.

Exacting Job Requirements

This job calls for thorough engineering study in the temporary work and plant layout as well as careful planning to minimize delays to railroad and vehicular traffic. Close supervision is also necessary to avoid economic losses possible because of the many necessary restrictions imposed by the specifications. The contract is being performed as a joint venture of the The Arthur A. Johnson Corp. and Mason & Hanger Co., Inc.

Cheaper Harbor Control Methods Called Challenge to Profession

(*Continued from page 48*)

normal development of the harbors of a nation also tend to restrain its economic advance. Sedimentation is probably the dominant natural force tending to restrict the development, expansion and maintenance of harbors."

Calling harbors the works of man in artifically increasing depths of water over those normally existing, Mr. Caldwell depicted the battle engineers have been waging against the tendency of natural forces to restore the normally existing depths. He classified harbors in four categories—river-channel, fall-line, tide-

(*Continued on page 99*)

(Continued from page 98)

ater and shoreline—and discussed shoaling endencies and techniques applied for each.

Discussing the magnitude of the edimentation problem and the need or maintaining access channels, he aid of the approximately one thou- and public navigation channels and ublic harbors of the country:

Maintenance work has entailed the removal of an average of 185 million cu yd each year for the past seven years. The magnitude of such quantities of material is difficult to grasp; so it might help to picture the quantity dredged as being sufficient to cover Manhattan Island (22.24 sq miles) each year with a layer of sand and muck about 2½ ft deep. The maintenance costs of these channels and harbors for this period, of which the bulk was spent on removal of shoals by dredging, has been about 48 million dollars per year for this same period.

In calling on America's engineers to accept the challenge offered by these quantities and costs, Mr. Caldwell urged "studies of means to lessen the rates of shoaling in our harbors and navigation channels and studies of means to reduce the costs of dredging by increasing dredging efficiency."

Authorities Predict No Decline in Construction Volume

(Continued from page 33)

concluded that there is money for construction, and that if taxes are larger, it will be for public works, if smaller, there can be more private work. Public construction is going up about 25 percent to $5 billion by taking deferred projects off the shelf. With funds from ERP and from counterpart funds, more foreign construction work will be financed. Most materials will be available in 1949 in greater amounts and at equal or perhaps lower prices than in 1948. Labor is almost certain to press for increased wages either in name or through "fringe demands." Improved standard construction equipment is available on three months' notice, but at prices that are to remain high. Special equipment is in short supply and for long-time delivery.

Construction uncertainties for 1949 are no worse than for 1948. The forecast is generally optimistic. "My conclusion," Mr. Bowman said, "is, Let's go! What are we waiting for?"

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Earth Boring Machine

TREMENDOUSLY ENLARGING the scope and field of bucket type drilling operations, with subsequent savings in time and labor costs, are some of the claims made for the earth boring machine by its manufacturer. Built as a self-contained unit on skids which can be mounted easily on any truck chassis $1^1/_2$ tons or larger, the machine is specifically recommended for sewage disposal, water well and calyx drilling, soil testing; for drilling pier holes and belled footings and for oilfield work. It drills

Self-Contained Boring Unit

from 10 to 72 in. holes 200 ft. deep. Further information may be obtained on actual case histories of jobs performed with the machine by writing to **California Welding & Blacksmith Shop, Inc., 7222 E. Slauson Ave., Los Angeles 22, Calif.**

Pneumatic External Vibrator

THE MODEL PX-6 pneumatic external vibrator has been widely accepted in concrete pipe production, and is used in many packaging operations. Weighing only 40 lbs. this vibrator is $5^1/_2$ in. in diameter and 12 in. long. The correct amount of amplitude is obtained through proper selection of a rotating weight. Driven at the desired speed by regulating the air pressure, the PX-6 is so versatile it fulfills the requirements of external vibration problems. **Viber Co., Burbank, Calif.**

Streamlined Compressor

WEIGHING ONLY 950 lbs the streamlined OK compressor SS60, delivers 60 cu ft of free air and can easily be towed or carted to the job. A radical innovation is the use of Ford motor and standard automotive parts. Air tank capacity is 4 cu ft. Use of an extra large air receiver enables maintenance of greater air supply without overworking parts. It is water jacketed to protect against overheating for efficient operation in all climates. **O. K. Clutch & Machinery Co., Columbia, Pa.**

Combination Blast Gun

A VERSATILE ADAPTION of sand blasting and solvent spraying is the enpro combination blast gun. The gun improves and simplifies surfacing, production, cleaning and finishing in automotive and industrial fields. Air operated, portable and efficient, the gun leaves no buffing marks, no grooves or ridges, no scuffed, gouged or uneven surfaces. The gun has no shafts to break, no wheels to dress and no motors to burn out. It is particularly useful in reaching inaccessible places such as wheels, drip mouldings, grill work, brick and rough-finished walls, crevices and close fittings. The gun balances perfectly in the hand, is light to handle and easy to use. Simply point the gun at the surface to be prepared and pull the trigger. Paint melts away, rust, scale and oxidation disintegrate. Solvents penetrate to flush out grease, gum and tar. Oils and liquids penetrate where needed. **Engineered Products, Inc., 1324 Speer Blvd., Denver, Colo.**

New Features on Midget Pavement Breaker

A NUMBER OF new features are now being incorporated into the mighty midget pavement breaker manufactured by the R. P. B. Corporation. It is claimed that the new machines show important gains in yardage of concrete broken in a day's operation. All controls are within easy reach of the operator's seat which is placed directly behind the machine, allowing the operator to see exactly where and how the hammer contacts the pavement at all times. A conventional steering wheel has been added which fits alongside the machine and is readily reached. Worm drive tends to hold the front wheel much steadier under difficult conditions. Higher wheels allow the machine to run through broken concrete and remain on a straight course, without sinking into the concrete. The midget has been widely accepted since its recent introduction and it is hoped that the improved machine will prove to be of even greater value to the industry. **Rapid Pavement Breaker Co., Los Angeles 23, Calif.**

Roller Guides for Elevators

THROUGH THE USE of Elsco roller guides an elevator is provided with a quiet gliding operation that has many advantages, particularly electric current consumption being greatly reduced through their use. Reports indicate after considerable testings and recordings, under a multitude of conditions and on a diversity of elevators, that there has been a minimum of 24% and a maximum saving of 44%. Elsco roller guides run on dry rails. Hoistway may now be free of all grease, oils or oil lubricators, thereby eliminating the great ever-present fire hazard. **Elevator Safety Corp., 165 Broadway, New York City 6, N.Y.**

Dimensioner

THE NEW NO. 60 dimensioner template, for use in all phases of drafting, is announced by Rapidesign, Inc. The No. 60 dimensioner template speeds up the call-out, dimensioning and lettering of drawings. An indispensable template where drafting procedure requires uniformity. All symbols and sizes conform to standard drafting room practice. The dimensioner is made of 0.040 super quality cellulose nitrate. Beveled cutouts of symbols are precision milled to give utmost in accuracy. Actual size is 4 x $3^1/_4$ in. and the price is $1.00. Write **Rapidesign, Inc., P.O. Box 592, Glendale, Calif.**

Plaster Mixer

A NEW PLASTER MIXER now being marketed is of 6 cu ft capacity, and according to the manufacturer, was designed to meet the rough working conditions so often found on plastering jobs. It is driven

Engine-Driven Mixer

by a Briggs and Stratton engine through a heavy roller chain drive, and is equipped with a bag shelf and a bag splitter. Fabricated of steel throughout, it has disk-type wheels with Timken bearings and pneumatic tires. A telescopic towing bail is provided. **Muller Machinery Co., Inc., Metuchen, N.J.**

New LeTourneau Products

TOURNADOZER-MOUNTED SNOW PLOW—A snow plow designed for use with the LeTourneau Model C Tournadozer has been developed. Made for heavy duty work, this "V" type plow has ample strength built into the plow base, moldboards and push-arm structures to enable it to bust big drifts and move wet and frozen snow. Fast acting cable operated controls permit raising the plow 5½ ft. to handle high bank jobs. Three adjustable steel runner shoes permit the plow to be "nosed up," "nosed down," or adjusted for cutting height. When the snow removal season is over, the rig can be quickly transformed to a dirtmoving tool simply by replacing the snow plow with the dozer blade.

Snow Plow

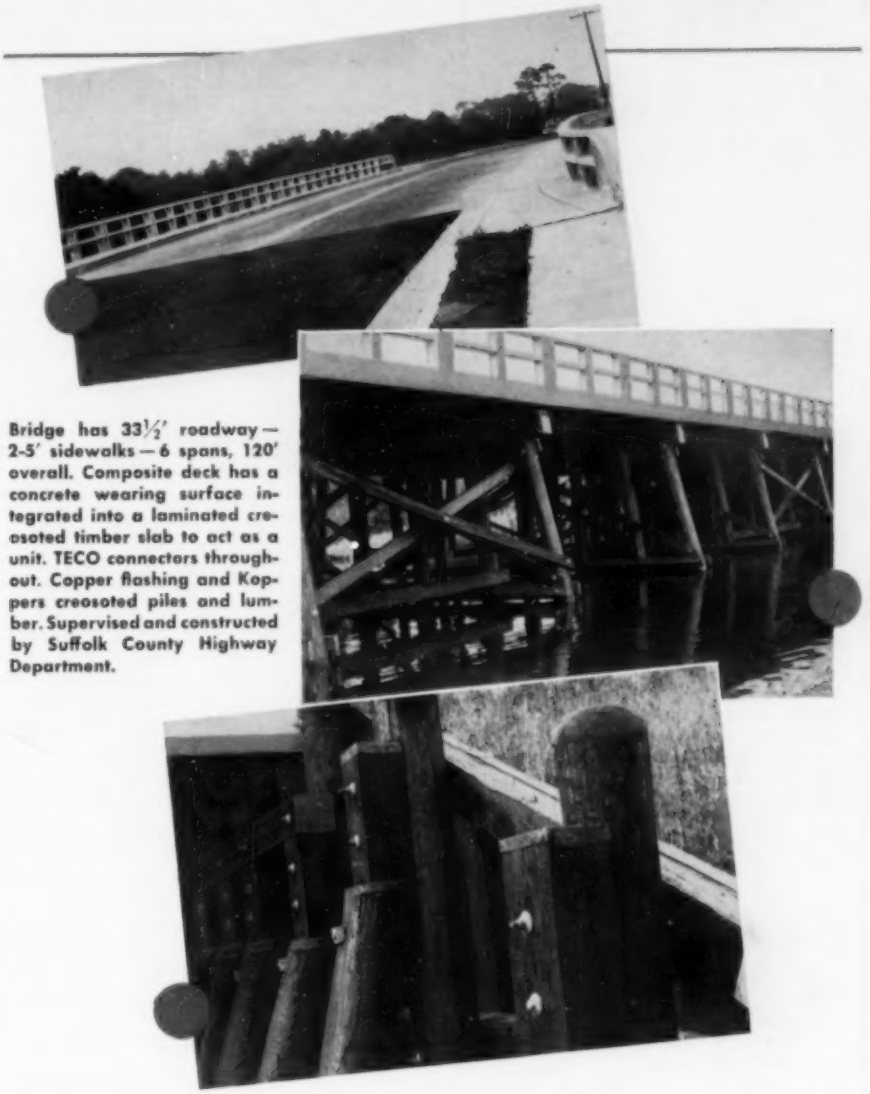
REAR DUMP ROCK WAGON—Especially suited for construction work is a rear dump wagon, the E-16 Tournarocker, designed to be loaded by shovel or dragline. It has a struck capacity of 16 tons and is able to turn around in a 12½ ft radius, thus having no difficulty in operating in cramped dump areas. Material is dumped behind its rear tires by locking brakes on rear wheels and raising the bowl by means of a tournatorque electric motor and cable attached to bottom rear of bowl. An electric motor cable control enables the machine to dump while traveling. Additional information on the tournarocker which is built to handle dirt and bulk materials as well as rock may be obtained. **R. G. LeTourneau, Inc., Peoria, Ill.**

Rear Dump Rock Wagon

Correction

THE DESCRIPTION OF the new Galion Scoop Loader which appeared in the January issue contained an error in the address of the manufacturer. The correct address should be **The Galion Iron Works & Manufacturing Company, Galion, Ohio.**

THE "SUPPORTING" ROLE THAT'S STEALING THE SHOW



Bridge has 33½' roadway — 2-5' sidewalks — 6 spans, 120' overall. Composite deck has a concrete wearing surface integrated into a laminated creosoted timber slab to act as a unit. TECO connectors throughout. Copper flashing and Koppers creosoted piles and lumber. Supervised and constructed by Suffolk County Highway Department.

● Along with the nation's steadily increasing amount of transportation comes ever-increasing praise for Koppers Pressure-Creosoting.

Its performance on piles, decks, posts, and guard rails has led highway engineers across the nation to report that "Koppers Pressure-Creosoting does the job."

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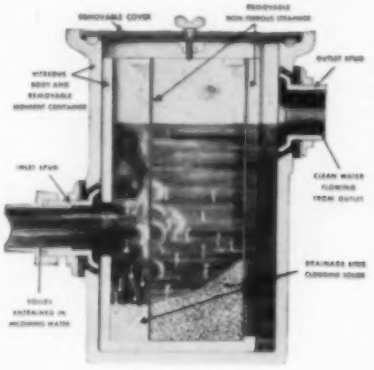
Solids Interceptor

A SOLIDS INTERCEPTOR has been developed to prevent fragments of solids present in waste water from flowing into building drainage lines thereby causing costly trouble and inconvenience. The unit has been designed to permit easy and quick cleaning unobtainable by old-style traps and makeshift arrangements. The impervious, non-metalic cover is easily removed by unlocking a cover clamp. The



Interceptor

intercepting function is accomplished by two perforated metal strainers which intercept the solids in the waste water as it passes through the interceptor body. The perforated metal strainer nearest the inlet intercepts the larger fragments; the second metal strainer completes the interception of all solids passing through the interceptor. The solids drop to the bottom of the sediment container where they are collected for removal. For further information write **Dept. Z-6, J. A. Zurn Mfg. Co., Erie, Pa.**

Automatic Line Oiler

A LINE OILER that protects against running rock drills or other air actuated equipment being without adequate lubrication has just been announced by Gardner-Denver Company. Known as the LO12 automatic line oiler, this device shuts off the line air automatically when all the oil in the reservoir has been used. Thus there is no chance, the manufacturer states, for equipment to operate without proper lubrication. In operation, the line oiler delivers a carefully metered flow of atomized oil from any position, either vertical or horizontal and all of the oil is consumed. The flow of oil is metered so that any pneumatic equipment using from 25 to 500 cu ft of air per min can be efficiently lubricated. It is easy to service, for all parts may be withdrawn by hand, once the bushing on the inlet end has been removed. **Gardner-Denver Co., Quincy, Ill.**

When writing for Information, please mention CIVIL ENGINEERING.

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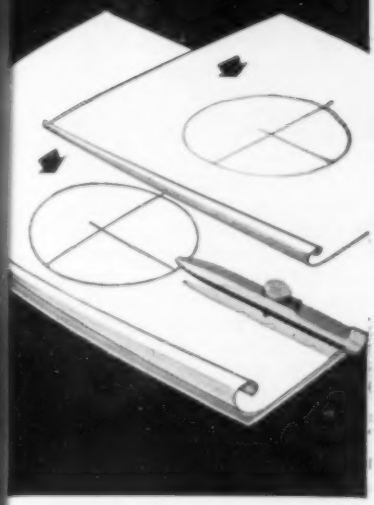

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Literature Available (Continued)

BITUMINOUS DISTRIBUTORS—The leadership established in this field has been maintained by Kinney Manufacturing Company to the present time. They are offering Bulletin A-48, gives detailed information, diagrams, specifications, dimensions and weights on Kinney distributors. This type of equipment is used in large numbers by state, county and city highway departments and by private contractors. **Kinney Mfg. Co., Boston 30, Mass.**

BLASTING NOZZLES—An attractive 2-color catalog illustrating the complete series of super-titan blasting nozzles with the exclusive titan tungsten carbide liners and accessories is now available without cost. Special booklets have also been prepared with valuable tips on the use of blasting nozzles in sand-blasting, foundry and heat treating, glass and monument decorating, building cleaning, railroad and shipyard maintenance and cleaning. **Mills Alloys Inc., 11320 South Alameda, Los Angeles, Calif.**

CRAWLER TRACTORS—In a series of colorful new mailing folders, A-93-LL, A-92-LL, A-207-LL, A-206-LL, the Industrial Power Div. presents design and performance details on four International diesel crawler tractors. TD-18 of 80.5 drawbar hp, the 57 hp TD-14, and the TD-9 and TD-6 models of 39 and 29.5 drawbar hp, respectively. Profitable work applications of each are spotlighted in job shot illustrations. Sectional views of the tractors reveal engineering construction details developed to increase operational economy and efficiency. **International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

STEELMAKING—The story of modern steelmaking, from the mines to finished steel, is informally told in a new 64-page booklet, "How Steel Is Made," just issued by Inland Steel Company.

Liberally illustrated with sketches, diagrams, and photographs, "How Steel Is Made" was planned primarily for the layman—executives who buy and use steel, workers who fabricate steel, engineering students, and others to whom steelmaking is of interest.

The booklet begins with a brief historical outline of steelmaking, then describes the many phases of modern steel production—mining of the essential raw materials for steel manufacture; methods of making pig iron and steel; pouring, soaking, and blooming of the ingot; and, finally, rolling of the many finished and semi-finished steel products. It dwells momentarily on modern quality control and research procedures, and includes an informative exhibit showing the microstructure of various steels. From cover to cover it is written in the non-technical language of everyday life—interesting and intelligible—yet authentic and comprehensive.

Copies of the booklet are available on request from **Inland Steel Company, Room 1271, 38 S. Dearborn St., Chicago 3, Illinois.**

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Literature Available (Continued)

PILE HAMMERS—Newly revised with additional information and illustration are two booklets on single-acting and double-acting pile hammers. Both bulletins contain revised specifications, operating instructions and a listing of component parts. Useful formulas for computing the bearing capacity of piles are accompanied with photos of extractors on the job. **McKiernan-Terry Corp., 15 Park Row, New York 7, N.Y.**

SNOW REMOVAL BOOKLET—Each year highway officials are increasingly aware of the importance of keeping highways open the year 'round. People in the winter states are dependent upon safe, available transportation whether it be city, county, state or nation travel. The continual battle of highway crews night and day against severe weather conditions is shown in the current 11-page booklet "Beating Back the Blizzards," otherwise known as Form 11699. **Caterpillar Tractor Co., Peoria 8, Ill.**

TUNNELING LITERATURE—"Tunneling for Profit and Convenience" is the title of a 4-page folder recently published. Stress is placed on tunneling as an economical means of avoiding inconvenience to traffic and loss of business to merchants and others. The use of light-weight corrugated liner plates has simplified tunneling procedure. Uses illustrated are for new sewers, relining of failing sewers and culverts, service tunnels for utility lines and pedestrial and livestock underpasses. **Armco Drainage & Metal Products, Inc., Middletown, Ohio**

PAVED CORRUGATED METAL PIPE—The advantages of flexible paved corrugated metal pipe in resisting corrosion, erosion, shearing and other damage is described in technical terms with typical applications and engineering data in a new 4-page illustrated bulletin. Illustrations show the flexibility, durability and four-way protection offered by United States Fabricators pipe. The bulletin graphically includes recommended gauges for highway and railway culverts, and areas and weights of this type pipe. **Mr. H. E. Arnsby, United Steel Fabricators, Inc., Wooster, Ohio**

ELECTRICAL EQUIPMENT—A 68-page technical catalog has been completed and is now being distributed to the trade. The catalog is profusely illustrated and gives full details on complete lines of enclosed safety switches, service entrance equipment, branch-circuit or residence panels, panelboards for light and power distribution and wireways and fittings. Valuable tables for the selection of switches, wire and fuse sizes for electric motors and other wiring data of value to engineers are featured. Distribution of the catalog is being confined to responsible persons engaged in specifying electrical equipment. **General Switch Corp., 44 Roebling St., Brooklyn 11, N.Y.**

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THE 1949 "TIMBERHOG" chain saw, available in 20, 24 and 30 in. cutting capacities, offers an exclusive 2-in-1 feature. With the addition of a helper's end, it's a two-man saw; without it, it's a one-man saw. The "Timberhog" is an all-purpose saw with an all-purpose chain. Whether you're cutting hard woods or soft woods, this fast-cutting chain will take them in stride. There is no need to change chains for cutting woods of different hardness. These saws are truly portable; the 20 in. model, complete with blade, chain, guide bar and bumper plate weighs only 55 lbs. A pressure-fed diaphragm carburetor permits cutting at any angle, the full 360 degrees eliminating any need for swiveling the blade or the carburetor. A light-weight 4 hp gasoline engine powers the "Timberhog" 2-in-1 saw and delivers power far in excess of load requirements. **Reed-Prentice, Dept. 57, Worcester 4, Mass.**

Literature Available

PNEUMATIC GROUTER—A 4-page bulletin, designated as No. 13, discusses grouting and its many uses in heavy construction. It gives detailed information on the places where grouting is generally specified such as shafts, tunnels and dams. Several diagrams accompany the operation and mixing data. **Robert S. Mayo, Lancaster, Pa.**

INDUSTRIAL PLANT DISTRIBUTION SYSTEMS—Detailed information about industrial plant distribution systems is given in a new 32-page booklet. Complete colored diagrams of eleven basis distribution systems, detailed descriptions of the operating principles of the systems and numerous photographs are included. **Westinghouse Electric Corp., P. O. Box 868, Pittsburgh, Pa.**

PLYWOOD INFORMATION—Data is offered in the form of a 25-page booklet on the production, use and distribution of Douglas Fir Plywood. It is published in question and answer form to provide the information sought by distributors, dealers and consumers. Also offered is a copy of the new Commercial Standard, CS 45-48, which contains an analysis summarizing the principal changes. **Douglas Fir Plywood Association, Tacoma 2, Wash.**

STEEL FORMS—Plans and techniques for the building of gravity dams and walls with Atlas steel forms are described in a brochure. This handy 4-page leaflet contains instructional material, including two helpful plans: "Typical Details of 'A' Frame Hoists, Showing Use on Upstream, Downstream and Bulkhead Forms," and "Details of Special Forms at Pier over Weir and Application of Standard Forms for Crane-Handled Pier Forms." There is also an illustration of typical layouts for training wall forms. **Irvington Form & Tank Corp., Irvington, N.Y.**

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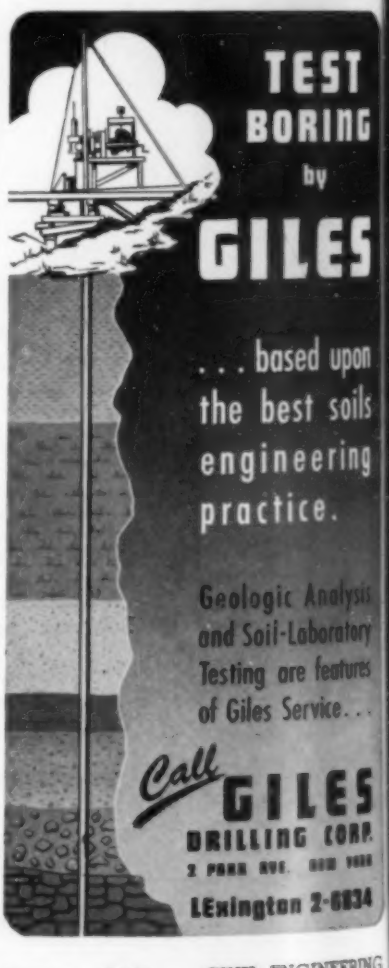

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Fig. B-68. Type M (Circular) Gate

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Literature Available (Continued)

ROAD SWEEPING MAGNETS—A bulletin, No. B-1302A, describing the new Dings high intensity road sweeping magnet for removing nails, spikes, sharp pieces of steel, and other tramp iron hazards from roads, air field landing strips and aprons, parking lots, factory aisles, etc., has just been released. The magnet is designed for mounting on a truck with power supply from a portable engine-generator set. It has a triple pole design that gives strong penetration, an even field across the entire width, and a magnetic pickup effective to about 12 in. from the magnet face. **Dings Magnetic Separator Co., 4740 W. McGeogh Ave., Milwaukee 14, Wis.**

Films Available

FILING METHODS—"It Must Be Somewhere!," a new, color motion picture portraying the vital importance of simplified, efficient filing methods in business, has just been released. The story runs 28 min and highlights the contrast between the old-fashioned, poorly lighted, badly located and crowded file room and the airy, streamlined efficiency of a scientifically laid-out and correctly operated filing department. **Systems Div., Remington Rand Inc., 315 Fourth Ave., New York 10, N.Y.**

WIRE ROPE—A colorful four color sound film entitled "Indian Paint" is now available for public showing. The picture runs for 35 min, vividly portraying the making of steel from ore to finished product—wire rope. Arrangements can be made for the showing of the film, without obligation before any group or organization by writing to **The Colorado Fuel & Iron Corp., Wickwire Spencer Steel Div., Palmer, Mass.**

MOTOR SCRAPER—A movie entitled "Profit Report" has recently been released. The color-sound movie shows various job applications of the company's high speed, rubber-tired unit, the TS-300 motor scraper. The picture, with a 22-min running time, can be viewed at the firm's distributors. It is also available for loan to schools, clubs or other organizations by the company **LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa**

MASS HANDLING TECHNIQUES—An exceptionally informative industrial sound-movie is now being released for showing at groups and meetings. With the appropriate title of "The One-Man-Gang," this 30-min picture takes its audience into the plants of a number of leading manufacturers to show the methods being employed to make reductions in the costs of materials handling. By observing the actual applications of the modern principles of in-plant materials handling, one gains a knowledge of just how vital fork lift trucks and tractors have become in plant operation. **Towmotor Corp., Cleveland, Ohio**

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